Wichita River Basin Reevaluation
Red River Chloride Control Project

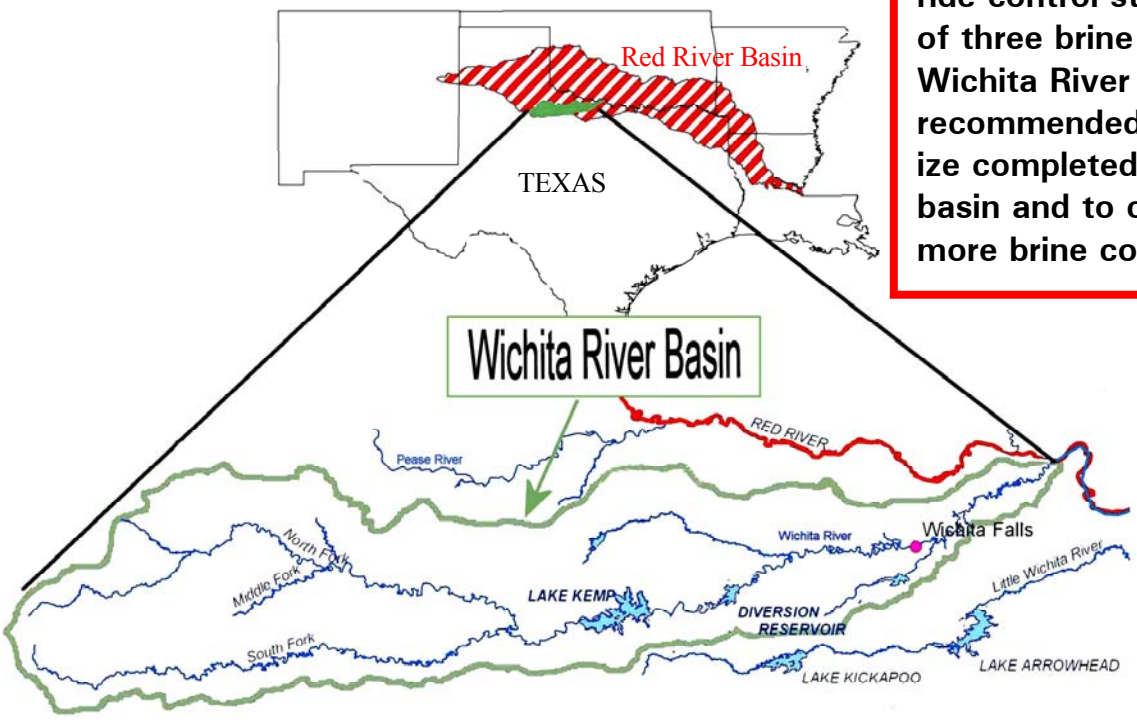
This handout has been prepared for those interested in the most recent study findings of chloride control in the Wichita River Basin. Huge amounts of data have been compiled and this information has lead to a better understanding of chloride control issues. The intended audience for this summary is the general public. Following the introduction, the handout is organized in three sections.

- The **first section** describes the study area, the recommended chloride control components, and a brief explanation of their operation.
- The **second section** briefly describes what chloride control will do in terms of positive and non-positive effects.
- The **third section** is a series of questions and answers, similar to a FAQ or frequently asked questions list on the Internet. The brief statements address many of the concerns previously expressed and attempt to cover the issues continuing to be discussed by agencies and stakeholders.

In 1957, the Public Health Service began studies to determine the causes of natural pollution in the Arkansas and Red River basins. They concluded that chlorides and sulfates are the principal natural pollution.

In 1959, Congress authorized the Corps of Engineers to enter the study. The Public Health Service would identify the salt sources and the Corps would develop the plan to control the salt. Fifteen natural sources were identified.

In 2002, the scope of chloride control studies consists of three brine springs in the Wichita River Basin. The recommended plan is to utilize completed features in the basin and to complete two more brine control features.



Introduction

In 1994, the U.S. Army Corps of Engineers suspended construction of the Red River Chloride Control Project. The Corps had completed brine collection site Area V (Estelline Springs) in 1964, the Truscott Brine Lake in 1982, and brine collection site Area VIII in 1986. Brine collection site Area X was under construction at the time. Construction was stopped due to concerns expressed by the U.S. Fish and Wildlife Service, the Oklahoma Department of Wildlife Conservation, and the Texas Parks and Wildlife Department regarding environmental issues and what they thought would result from construction of the chloride control project.

Although the Corps evaluated the concerns through detailed studies and addressed many issues, there continued to be disagreement. The Corps elected to suspend construction and work to resolve the issues through a process termed an environmental issue resolution process (EIRP).

Why stop construction if it wasn't necessary? The Corps felt that it was necessary. Achieving environmentally sustainable solutions requires collaboration among Federal, State, and local government agencies, and non-governmental organizations. Above all, Corps efforts focus on identification of reasonable and innovative alternatives and objective evaluation to achieve sustainable solutions. Collaboration with other agencies, stakeholders, and citizen groups is essential to ensure that Federal decisions consider the full range of consequences of actions. The Corps works to foster cooperation and build teams with other agencies; to confront and resolve both technical and social conflicts between those agencies; and, finally, to develop information in support of decisions. Individuals and organizations outside the Corps may have different mental models of the environmental issues we face as a Nation. Such individuals and organizations often have significant insights to contribute to the potential environmental solutions the Corps evaluates. We encourage this type of dialogue and listen to what our citizens and organizations have to say.

The EIRP discussions included several working groups and spanned December 1995 to July 1996. In the end, none of the issues had been resolved, but a process had been accepted by the three resource agencies whereby environmental monitoring would occur for those Red River Chloride Control Project features that had been constructed or would be constructed in the future. The purpose of the monitoring was to determine the actual effects of existing and future operating chloride control components on the environment. Many of the monitoring components included continuation of data gathering. Other components would be new data sources and would involve intensive initial data gathering (to establish a baseline) and periodic updates (to identify trends of change). The monitoring was specified in an environmental operating plan to be conducted by the Corps for the entire Red River Chloride Control Project.

In a 1997 letter, the Texas Parks and Wildlife Department indicated that they would have no objection to the Corps completing construction of the chloride control features within the Wichita River Basin as a

test case, provided that adequate monitoring was included. The ongoing environmental operation plan provides that monitoring.

The Assistant Secretary of the Army for Civil Works, ASA (CW), approved of the approach to complete the Wichita Basin features. But the economic viability needed to be confirmed for controlling only two or three Wichita Basin areas independent of the overall Red River Chloride Control Project consisting of seven brine control areas. To address that concern, the ASA (CW) directed an initial review, then a thorough reevaluation of chloride control for those features within the Wichita River Basin. The reevaluation was to re-examine all data, assumptions, methodologies, and conclusions and was not to be constrained to the previously recommended or authorized chloride control plan.

From the time construction was stopped until 2002, various additional data were gathered and new monitoring activities were conducted as specified by the environmental operating plan for the Wichita River Basin features. All the additional data were used in the reevaluation study. This significantly expanded the Corps' understanding of the environmental effects of chloride control. The general findings were:

> *All potential chloride control issues and environmental effects were reassessed as related to the Wichita River Basin chloride control features, including related issues downstream in the Red River and Lake Texoma. The Corps' original conclusions of potential, but minor adverse effects were verified, but some of those effects were found to have been overstated. The recommended plan for the Wichita River Basin is economically viable; minimizes environmental impacts; and provides environmental, agricultural, municipal, and industrial water use benefits. The plan would fully mitigate the construction impacts to terrestrial habitat – generally mesquite and juniper. The only other mitigation measure would be to provide fish habitat in Lake Kemp.*

Study Authority. In September 1997, the Office of the Assistant Secretary of the Army (Civil Works) directed the Corps of Engineers to prepare an informal economic analysis of completing the Wichita River Basin features of the authorized Red River Chloride Control Project (RRCCP). It had been proposed that proceeding with completion of Wichita River Basin construction, in lieu of the total authorized project, would address recent geographic shifts in water demand, would avoid environmentally sensitive areas along the Red and Pease Rivers, and would minimize impacts to fish and wildlife species and habitat. Further, the reevaluation would identify opportunities to build upon previous RRCCP investments.

An informal economic analysis was developed using existing information. The analysis was completed in October 1997. Agricultural benefits were updated, and the economic justification was updated to include variations among water demand forecasts from the Red River Authority of Texas, the Texas Water Development Board, and those used in the evaluation. The economic analysis was presented in an October 1997 report to higher Corps head-

quarters, entitled Red River Basin Chloride Control Project, Evaluation of Wichita River Basin Completion. The findings indicated that completion of the Wichita River Basin chloride control features was economically feasible. The ASA (CW) concluded that a thorough reevaluation of the Wichita River Basin features was warranted.

Wichita River Basin Chloride Control Purpose and Scope. The Wichita River Basin portion of the Red River Chloride Control Project consists of features in and associated with chloride control in the Wichita River Basin, a tributary of the Red River, located southeast of the Texas panhandle, in Texas. The reevaluation study area includes north-central and northeastern Texas, including the Dallas-Fort Worth region and the region along the Red River as far downstream as Shreveport, Louisiana. The reason the study area is greater than the Wichita Basin is because related changes might reasonably affect these areas. The goal is to reduce naturally occurring chlorides in the Red River, and the Wichita River is one of its tributaries. Reducing chlorides will allow more economical use of these waters for municipal, industrial, and agricultural purposes.

Reevaluation Study Purpose and Scope. In December 1997, the Director of Civil Works, Major General Russell L. Fuhrman, approved, by letter, with concurrence from the ASA (CW), that the District could undertake the reevaluation. The study was to be titled the Wichita River Basin Project Reevaluation. This Reevaluation involves detailed formulation of alternatives and economic, environmental, and cost analyses. The purpose is twofold: (1) to provide a basis for the most appropriate course of action for the unconstructed features of the authorized project in the Wichita Basin, and (2) to reexamine the economic feasibility of various chloride control measures and alternatives and their potential environmental impacts. The Reevaluation does not address the overall RRCCP and its economic and environmental issues, so it does not change the general scope of the RRCCP. The Reevaluation study is an economic and environmental evaluation of chloride control measures within the Wichita River Basin.

Reevaluation Introduction. Over the 40 years the Corps of Engineers has studied chloride control for the Red River Basin in response to Congressional direction, the project has been the object of support and criticism. While the Corps has conducted and disseminated very detailed studies and has implemented relevant portions of the EOP, controversy continues concerning what environmental changes might occur.

It is important to know that no contradictory data, models, or results have been presented to the Corps. The data used by the Corps was accumulated from a variety of sources. The Corps collected additional field data necessary to fully evaluate potential chloride control alternatives. The Corps used its own computer models to evaluate data or worked with universities or engineering firms to use their models and expertise. The only disputes arise from individual conjecture or from alternate interpretation of the results produced by the Corps. However, how data are used and what results are obtained are both subject to variation, especially in water resources and environmental evaluations. Therefore, the course of action was to conservatively assess benefits and impacts. The evaluation

criteria and model conditions were selected to intentionally result in an overstatement of potential impacts and an understatement of potential benefits. Overall, the evaluations are conservative. Where data are limited, the evaluations are more conservative. Where data are plentiful, the evaluations are less conservative.

In the following sections, we present the proposed chloride control plan and address several of these conservative aspects. Although founded on the facts and findings of Corps' studies, the intent is not to present an excess of data or frequent literary references or to complicate the issues with overly technical jargon. There are a number of technical reports that fulfill the need and requirement for technical materials.

Section 1. Study Area, Components, and Operation.

Between 1957 and 1959, the U.S. Public Health Service identified 10 salt sources that collectively produced about two-thirds of the 3,540 tons per day of chlorides that enter Lake Texoma on the Red River. In 1959, Congress directed the Corps to determine if the salt sources could be controlled. The annual Red River chloride load is greater than the amount of salt consumed by humans and animals in the United States annually.

The first chloride control project was authorized in 1962 as an experimental project at Estelline Springs, Texas. The site was called Area V from the original Public Health Service study. Area V is simply a ring dike around the brine spring. It is 9 feet high and 340 feet in diameter. The

weight of the water contained by the dike stops the spring from flowing. It has stopped about 240 tons of chlorides (out of 300) from entering the Red River each day since January 1964. This feature is upstream of Lake Texoma; therefore, Lake Texoma no longer receives an average daily chloride load of 240 tons per day from Estelline Springs. This represents about a 7% reduction of the long-term chloride load into Lake Texoma (previously 3,300 tons per day).

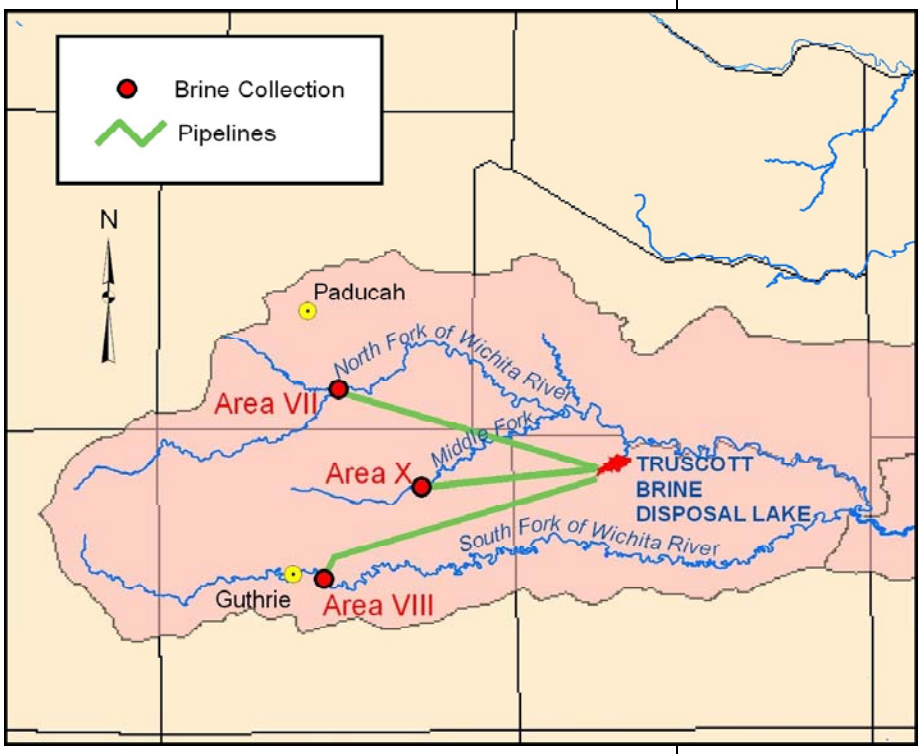
Based on the successful results at Estelline Springs, a formulation study was completed for control of chlorides at Areas VII, VIII, and X (all in the Wichita River Basin). The study was coordinated with the U.S. Fish and Wildlife Service, State agencies, and the public. *All Corps studies are coordinated in this way.*

In 1966, Congress authorized design studies for the Wichita River Basin. These were started in 1966 and completed in 1972. During these studies, it was concluded that the same technique use at Estelline Springs (the ring dike) would not work everywhere. Many other techniques were examined and the most appropriate technique for each brine source was selected. In 1974, Congress authorized construction of Area VIII on the South Fork of the Wichita River.

Area VIII was constructed and has stopped about 165 tons per day (out of 189) of chloride from entering the Wichita River and the Red River downstream since May 1987. This represents about a 5% reduction of the long-term chloride load into Lake Texoma. To function, Area VIII has to pump collected brine through a pipeline to a storage and evaporation reservoir. That is the purpose of the brine disposal reservoir, Truscott Brine Lake. Truscott was originally designed to hold brine from Areas VIII and X. I*t will be explained later how brine from Area VII can also be stored*

there. The other authorized but unconstructed features in the Wichita River Basin, Areas X and VII, are designed to remove an additional 244 tons per day of chlorides (out of 302) from the Wichita and Red Rivers.

The remainder of this section describes the recommended plan for Wichita River Basin chloride control. The process of evaluation involved review and analysis



of many methods of "controlling" the brine springs and seeps. Deep well injection facilities were investigated, but costs were found to be excessive to operate and maintain. Also, the opportunity to use deep well injection at brine source areas depends on the suitability of the local geology. Previously identified brine sources were examined in a variety of combinations and levels of control. The combinations included not controlling brine at some locations.

The recommended plan would: (1) pool the brine from streambed brine springs behind three small in-channel dams about 5 feet tall, (2) pump the brine by pipeline to a brine reservoir, and (3) store and evaporate the brine for 100 years or until new technologies altered the need or purpose of chloride control.

The brine springs are located on or along the North, Middle, and South Forks of the Wichita River. The collection areas are called Area VII (on the North Fork), Area VIII (on the South Fork), and Area X (on the Middle Fork). The storage reservoir is called Truscott Brine Lake. The Crowell Mitigation Area, acquired prior to initiation of this Reevaluation, will serve to mitigate terrestrial impacts.

Area VII. The Area VII brine source and collection facilities are located about 8 miles southeast of Paducah in the southeastern quarter of Cottle County, Texas. The area includes a 1-mile reach of the North Fork of the Wichita River and a 3-mile reach of Salt Creek, a tributary to the North Fork. The North Fork of the Wichita River above the Salt Creek confluence contributes about 7% of the Red River's Basin total chloride pollution. The watershed above the site covers about 492 square miles. Flows from springs and seeps in Salt Creek average about 3.5 cubic feet per second (cfs) at the stream confluence during normal periods. The average chloride

load from Area VII is 244 tons per day. Area VII is projected to control 195 tons per day of chlorides. An inflatable dam will be used to hold about 80% of the site emissions for pumping. The maximum brine pool would cover 14 acres and contain 22 acre-feet of brine for pumping. The authorized project formulation determined that the pumped flows would be permanently stored in a planned storage reservoir called Crowell Brine Lake.

Crowell Brine Lake was designed (and authorized) to hold brine from Areas VII and IX (on the Pease River). However, this report will present a plan to store Area VII brine in Truscott Brine Lake using a 15-mile pipeline across portions of Cottle, Foard, and Knox counties. The pipeline would impact 181 acres of terrestrial habitat composed of mostly mesquite/juniper. The collection facility would impact 20 acres of mesquite/juniper habitat. An access road would impact another 10 acres of mesquite/juniper habitat. Part of the plan to store brine from Area VII in the Truscott reservoir includes concentrating the brine before pumping. The brine would be concentrated by evaporating about 25% of the water, leaving all the salts in a more concentrated form to pump to Truscott. The spray field area would impact about 42 acres of mesquite/juniper habitat.

Area VIII. This facility has been in operation since May 1987 pumping brine through a 22-mile-long pipeline to Truscott Brine Lake. The Area VIII brine source and collection facilities (Bateman Pump Station) are located on the South Fork of the Wichita River about 5 miles

east of Guthrie, near the center of King County, Texas, and about 4 miles north of U.S. Highway 82.

The South Fork watershed above the facility covers 221 square miles. Four springs that emerge from cavernous openings in the gypsum cliffs on the north side of the river have combined flows of approximately 2 cfs. The water level of the springs at the openings is only a few feet above the water level of the stream.

Brine seeps at Area VIII produces an average daily chloride load of 189 tons. Area VIII controls 165 tons per day of those chlorides. The pipeline easements cover about 346 acres. The total easement acreage was estimated for impacts to habitat, mostly mesquite/juniper, and is included in terrestrial mitigation at the Crowell Mitigation area. Not all of the easement was impacted during construction, and some mesquite/juniper is expected to re-grow. The areas that will be kept clear of brush will be the inspection trail and the pipeline footprint.

The brine collection facility consists of an access road, a low-flow dam to collect brine, and a pump house. A fabric weir on top of a concrete dam is inflated to retain brine for pumping and deflated to pass heavy stream flows of lower concentrations. At the top of the weir, the pool covers up to 30 acres and stores up to 80 acre-feet of brine.

Real estate already acquired for the facility totals about 76 acres. A portion of the 76 acres involves 46 acres of terrestrial impacts to mesquite/juniper habitat, which are included in terrestrial mitigation at the Crowell Mitigation Area.

Future plans for Area VIII include acquiring an additional 37 acres to construct an evaporation spray field to concentrate the brine before pumping to the Truscott reservoir. The spray field would reduce the volume of brine to be pumped and reduce storage requirements at Truscott Brine Lake.

Area X. The low-flow dam and pump house were completed before construction was interrupted in 1997; however, the brine pumps were not purchased, and the pipeline was not constructed. The inflatable dam is functional. The brine pool can cover up to 5 acres and contain up to 10 acre-feet of brine for pumping.

The watershed above the site covers 61 square miles. The Area X brine source and collection features are located about 13 miles northeast of Guthrie in King County, Texas, on the Middle Fork of the Wichita River.

The salt springs and seep area extend about 6 river miles. Middle Fork becomes a perennial stream where the first brine seeps appear. Seeps appear along both sides of the stream, emerging from gypsiferous shale at the base of vertical cliffs that partially define the margin of the alluvial plain. During dry seasons, a salt crust forms on the seeps. One spring found in the area has a flow of 0.7 cfs.

The Middle Fork contributes about 58 tons per day of chlorides, or about 12%

of the total Wichita River Basin salt load. The plan is to control 49 tons per day of chlorides. The Area X pipeline to Truscott Brine Lake will be about 10 miles in length and will impact about 146 acres of mesquite/juniper habitat. The collection

area impacts about 42 acres of mesquite/juniper habitat. An evaporation spray field at this site would impact about 32 acres of mesquite/juniper habitat

Truscott Brine Lake. This existing disposal area is at mile 3.6 on Bluff Creek, a south bank tributary of the North Fork of the Wichita River. Real estate acquired consists of about 4,006 acres in fee and about 136 acres in easements. The area consists of the project office and facilities, access roads (about 90 acres); the brine disposal reservoir; and fresh water lakes (about 134 acres). The earthen embankment for the brine lake has a height of 100 feet above the streambed and a length of about 14,800 feet (about 110 acres).

The brine lake will have a surface area of about 3,303 acres at the top of the brine storage pool. The pool elevation will vary with brine source and evaporation conditions.

When the area of the brine pool approaches the top of the brine storage pool, the volume of water that evaporates will equal the volume of brine pumped into the reservoir (and rainfall). Long after 100-years accumulation of brine and sediment, the reservoir will still have storage capacity for a 100-year frequency storm.

Storing a 100-year storm would temporarily cover an additional 400 acres without releasing any water.

Truscott Brine Lake has filled to about elevation 1468.5, with a volume of 35,751 acre-feet of brine. While the dam has an emergency spillway, the reservoir was designed to hold all the pumped brine and rainfall on the Bluff Creek watershed and not release any brine back into the environment. The emergency spillway exists to prevent dam failure should an extremely large rainfall event occur after the brine pool fills.

The economic analysis is evaluated over 100 years because these efforts are major civil works features and that evaluation period is appropriate. The economic time period does not set a limit on how long the chloride control features can operate.

The physical life of the facility is not limited to 100 years, and the chloride control areas could operate indefinitely with proper maintenance. When the area of the brine pool is large enough, evaporation from the lake will match the amount of rainfall and brine going into the lake. In the event of changing climate, adjustments to increase or decrease evaporation measures or the pumping rates can be made to prolong chloride control operations and optimize its effectiveness.

Crowell Mitigation Area. The Red River Chloride Control Project mitigation area is located in Foard County about 8 miles northwest of the city of Crowell, Texas. The area includes Canal Creek, a south bank tributary of the Pease River.

About 11,954 acres are currently owned by the Federal Government and held by the Corps of Engineers. The U.S. Fish and Wildlife Service and the Texas Parks and Wildlife Department currently judge these lands sufficient to offset all terrestrial impacts of chloride control features, constructed and proposed, in the Wichita River Basin, which comprise about 4,417 acres of lost habitat. The impacted habitat was primarily composed of mesquite/juniper and small amounts of crop and range habitat.

The primary purpose of the mitigation land is to offset or replace terrestrial habitat losses due to construction of project features. The greatest value for the Crowell mitigation land can be realized through management of fish and wildlife resources to provide the public with fishing and hunting opportunities. Native species include white-tailed deer, mule deer, scaled quail, bobwhite quail, Rio Grande turkey, cottontail, mourning dove, and migratory waterfowl. Hunting opportunities for these species and feral pigs will be available.

Several farm ponds are located within the mitigation area and constitute the major aquatic resources that have management potential for warm water species. Characteristic species found in ponds of this region include green sunfish, bluegill, orange spot sunfish, largemouth bass, crappie, common carp, black bullhead, and channel catfish. Vegetation generally consists of woodland, mixed shrub savannah, upland grassland, and bottomland grassland. A small amount of riparian vegetation and marsh communities are present.

While hunting and fishing opportunities currently exist, these opportunities will be improved with future management. No current or projected recreation benefits related to the Crowell mitigation area are included in the economic evaluations within the Reevaluation.

For every acre lost to construction activities, 2 to 3 acres will replace the value of habitat lost. In addition, the acquired area is to be managed to increase habitat value.

The largest single impacting feature was Truscott Brine Lake, which will cover about 3,303 acres at its conservation pool. *The terrestrial impact acreage in the table below (4,069 acres) reflects a*

conservative estimate of mesquite/juniper impact of a 100-year flood event being stored above a full brine pool.

The second largest habitat impact would result from clearing for construction and maintenance of the brine pipelines. The pipeline right-of-ways are partially cleared of brush. Cover by native grasses is (and will be) encouraged.

The table below shows the chloride control features that impact (or when implemented would impact) terrestrial habitat. The terrestrial impacts relate to the loss of habitat due to clearing for pipelines, pump houses, electrical line right-of-ways, access roads, the project office and facilities, Truscott Brine Lake, and created fresh water lakes. Most of the habitat impact is to mesquite and juniper.

Summary Land Use and Changes Wichita River Basin Chloride Control Features and Crowell Mitigation Area* (All units in acres, unless noted)				
Feature	Total Real Estate Acquired	Terrestrial Impact	Fresh Water Ponds Created	Brine Pool Created (acres/acre-feet)
Area VII	253	253	NA	14/(22)
Area VIII	429	429	NA	30/(80)
Area X	220	220	NA	5/(10)
Truscott Brine Lake	4,142	4,069	134	3,303/(120,760)
Total Project Feature	5,044	4,971	134	3,352/(120,872)
Total Crowell Mitigation Area (* Not in the Wichita River Basin)	11,954			

Section 2. What will the Wichita Basin Chloride Control Do?

Chloride control would have a number of primary benefits. These benefits were the object of the Congressional direction to the Corps of Engineers to implement chloride control measures. As such, they are the intended results. However, benefits are not the only measure of a project; the Corps is concerned about all aspects of a project. Whether dealing with costs, benefits, social, or environmental issues, the Corps works to formulate projects for economic development that are environmentally sustainable.

The Corps recognizes that some people believe simultaneous attempts to achieve environmental sustainability and economic development are antithetical forces. The Corps does not hold this position but rather understands that we can choose to design and act either in conflict with nature or in ways that take inspiration from nature and are modeled after it.

Lieutenant General Robert B. Flowers,
Chief of Engineers

The following terms are used heavily in this section. The definitions may help.

Concentration is the amount of something within something else. An example would be a spoonful of salt in a glass of water. Most dissolved solids (like salt) are described in this report as milligrams per liter {mg/l} (about the same as parts per million {ppm}; therefore, 1mg/l equals about 1 ppm). *The Texas water quality standard for chlorides in a municipal water supply, for example, is 300 mg/l.* When there is very little of something within another, the units are changed to allow for easier discussion of numbers. This is the case for selenium where the units are micrograms per liter {µg/l} (approximately the same as parts per billion). For example, the highest selenium concentration measured from the natural brine spring flowing from the Middle Fork to the Wichita River is 16 µg/l. *The Texas chronic water quality standard for selenium is 5 µg/l.*

Load is the term used to describe the amount of dissolved solids (including chlorides, sulfates, or the total of all dissolved solids) that are emitted from a spring or passing a stream location (like a bridge) in a certain period of time. Due to the large amounts of dissolved solids in Wichita Basin streams, the load in this report is discussed in terms of tons of dissolved solids that pass a location in one day {tons per day}. Because the load fluctuates from day to day, all the daily loads are averaged and this average is used to describe the load. *Loads of dissolved solids in the Wichita Basin range from tens of tons per day to thousands of tons per day.*

Flow is the volume of water that passes a location in a specified period of time. *Load and concentration are related by the "flow".* Stream flow is measured as cubic feet per sec-

ond {cfs}. *Think of one cfs as about 7-1/2 gallons moving past a point every second.*

Storage is discussed as lake storage. It is measured in acre-feet. *Think of an acre-foot as one acre of flat land with water covering it 1-foot deep.*

Chlorides are a portion (the Cl portion) of sodium chlorides (NaCl) that are released to the streams from natural brine emissions. *Chlorides that pollute the streams as a result of oil and gas exploration or production or other human contributions are referred to as man-made chloride pollution. The water collected below the natural brine springs contains more than just sodium chloride. It also contains large amounts of sulfates and other dissolved solids, and small, but significant, amounts of selenium.*

Control describes the change from conditions that do not reduce chlorides to conditions with chloride reduction efforts in place in the future. Both conditions attempt to look into the future. Control is represented as changes in load and/or concentration and can be shown as a percentage reduction.

Salinity is a measure of the ionic composition of water. It is routinely measured with an electrical meter in units of parts per thousand (ppt). Chloride is only one of a number of ions that contribute to salinity. Ions are simply charged atoms or molecules. Where concentration deals with the amount of materials by weight or volume, salinity is a measure of the total electrical charge. **More information about ions**: *Negatively charged ions are called "anions" and include Chloride, Sulfate, and Phosphate. Positively charged ions are called "cations" and include Sodium, Potassium, Calcium, and Iron. These are fairly common items in our households, drinking water, and food.*

Benefits are the economic and environmental measurement of plans evaluated and recommended for implementation. Plans are derived from a systematic planning process that reflects reason, common sense, and sound judgment. Through planning, design, and implementation of measures, every effort is made to ensure both economic and environmental value is added to water resources. The process is grounded in the economic and environmental principles set forth in laws that apply to the Corps of Engineers, the Bureau of Reclamation, the Tennessee Valley Authority, and the Natural Resources Conservation Service. For these agencies, the Federal objective of water and related land resources planning is to contribute to national economic development consistent with protecting the Nation's environment pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements.

Selenium (Se) is a naturally occurring chemical element present in Wichita Basin water. It is a nutritionally essential element that, in proper doses, is beneficial to all living organisms. If present at high enough concentrations in aquatic environments, Se may be toxic to certain organisms.

While concentrations, loads, flow, and other data may be referred to by their average values or percentages, the evaluations in this report discuss the results of computer models that dealt with the most appropriate detailed values available, whether daily, monthly, or other units of measure. Averages or percentages are used to simplify presentation of these detailed models and results.

BENEFITS FOR AGRICULTURE. Following are items related to agricultural production that are projected to occur due to reduced chloride concentrations in irrigation water.

Irrigated Crop Yields. Lower chloride concentrations in Wichita River water used for irrigation will result in greater crop yields.

Use of marginal water quality, as affected by salinity, can reduce crop yields by 75%. Salts in irrigation water can cause reduced yields in several ways. The salinity can affect the ability of crop roots to absorb water in the soil. Plant roots all contain some level of salt. When the salt content in the roots is "higher" than that in the soil, the soil water is "drawn" into the roots. If the soil has high enough concentrations of salt, the water in plant roots can actually be drawn from the plants regardless of the amount of water available or applied.

Excess sodium in the soil can limit infiltration of rainfall and irrigation water and saturation of the soil below the surface. When irrigation water is sprayed on some crops, the sodium can cause leaf burn and defoliation. In more severe cases, high levels of sodium can cause crusting of the soil that can affect seed germination, oxygen levels, and nutrient levels. Crops yields can also be affected by specific components of salts, such as chloride, sodium, and boron, that are toxic to some crops.

Most irrigation in the Wichita River Basin is "flood" irrigation, with a limited amount of "drip" and "spray" irrigation. A reduction in irrigation water salinity will provide opportunities to expand crop types, utilize various irrigation methods, and expand the geographic area of irrigation. The University of Texas A&M, Texas Agricultural Experiment Station conducted evaluations of soils and crop types and estimated future irrigation practices and extent assuming implementation of chloride control.

Irrigation Leaching Fraction. Lower chloride concentrations will require less irrigation water to be used to flush or leach salts from the soils that can make fields non-productive.

As irrigation water is applied, evaporation causes the loss of water, but any salt in the irrigation water remains in the soil. Over time, these salts can accumulate and cause a number of farming problems. Irrigation leaching is the management practice that avoids the buildup of salt in the soil. Leaching is the application of more water than would otherwise be necessary to grow the crop with salt-free water. The excess water keeps the salts in solution and causes them to drain below the root zone. The excess amount is called the "leaching fraction". Rainfall also contributes to leaching and is considered when estimating the leaching fraction.

Having fewer chlorides in the irrigation water will reduce the leaching fraction and result in less pumping and associated energy operating costs. Lower chloride concentrations and less pumping time reduce both damage and wear on irrigation equipment, which results in less maintenance costs. Reduced irrigation costs would allow for more economical conversion of dryland farming to irrigated farming. Overall, this results in increased income. Reducing the leaching fraction also means that more water is available for other purposes. The University of Texas A&M, Texas Agricultural Experiment Station evaluated leaching variables and farm budgets assuming implementation of chloride control.

BENEFITS FOR MUNICIPAL USE. Following are items related to municipal use that are projected to occur due to reduced chloride concentrations in the Wichita River and Lakes Kemp and Diversion.

- Lower chloride concentrations will allow more storage from Lake Kemp to be used directly for drinking water by blending with existing fresh water sources (and/or)
- Lower chloride concentrations will result in less volume of high concentration brine discharge from the Wichita Falls reverse osmosis treatment plant.
- Using more storage from Lake Kemp for drinking water will allow less intensive use of Lake Arrowhead and Lake Kickapoo and would delay the need to expand water treatment facilities (such as reverse osmosis) or construct an additional water supply reservoir.
- Use of Lake Kemp for drinking water reduces the risk of water shortages in Wichita Falls and other supplied communities.
- Lower chloride concentrations require less processing time and cost for reverse osmosis treatment.
- Lower chloride concentrations result in less household plumbing and appliance damages and less frequent replacement.

BENEFITS FOR INDUSTRIAL USE. Following are items related to industrial use that are projected to occur due to reduced chloride concentrations in irrigation water.

- Lower chloride concentrations require less treatment for manufacturing processes.
- Lower chloride concentrations result in less system and equipment damage.
- Less damages result in less system and equipment maintenance costs and production down time.

BENEFITS FOR THE ENVIRONMENT. Following are items related to the environment that are projected to occur due to reduced chloride concentrations in irrigation water.

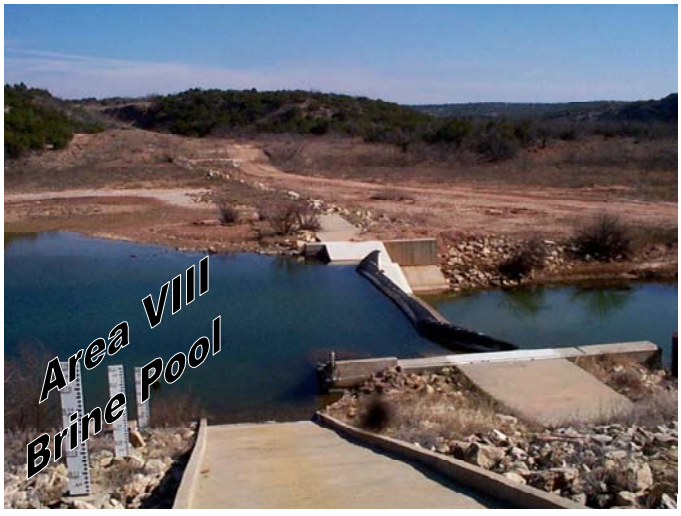
Reduced Risk of Selenium (Se) Poisoning in Basin Streams. Collection of brine on the North and Middle Forks of the Wichita River will reduce naturally occurring Se loads in the aquatic environment along those streams. The Texas Natural Resources Conservation Commission (TNRCC) agrees that this reduction in Se load may provide Se-related benefits to the North and Middle Forks of the Wichita River below the collection facilities. The TNRCC currently lists the reach below these brine sources as impaired due to the Se risk for wildlife.

Created Saline Tolerant Species Habitat. The low-flow dams on the Wichita River tributaries (Collection Areas VII, VIII, and X) will form the three largest permanent brine

pool environments along the upper basin streams. A large percentage of the naturally occurring downstream refugia pools are small and shallow. Natural refugia often occur where side streams enter at infrequent locations along the outside of stream bends, often where a stream flows against a rock outcrop. These areas are subject to drought and to human and cattle impacts.

The three low-flow dams will impound up to 112 acre-feet of brine and provide up to 49 acres of habitat. The two established pools (Area VIII and Area X) and the recommended third pool (Area VII) would provide stable habitat for saline tolerant species. These pools will be at the upper extent of habitat for these species. Above the brine seeps and springs, there is insufficient water to support persistent stream habitat. In addition, the low-flow dams will attenuate stream flow immediately downstream.

One of the completed sites (Area VIII) is operational and pumps brine. The other (Area X) is only impounding brine. Saline tolerant species are found in abundance at sites above and below the low-flow dams.



Reduced Risk of Fish Kills. Lower chloride concentrations in Lake Kemp, Lake Diversion, and the Dundee Hatchery may reduce the risk of harmful golden algae blooms. Golden algae (prymnesium parvum) are a marine species that produce toxins that can kill fish and mussels. The algae have been in the basin for an unknown period of time. It is believed that a golden algae bloom was responsible for the loss of striped bass and hybrid bass hatchery stock in May 2001.

The Dundee Hatchery produces almost 100% of the striped bass stocked in the State of Texas, and the TPWD estimates striped bass fishing related activities are valued at $150,880,000 annually. Any reduction of golden algae blooms in the hatchery would be valuable to that recreation interest. The Dundee Hatchery also produces a large percentage of catfish that are stocked statewide and large numbers of other game species that are stocked more locally. No data to specifically address the potential risk reductions of golden algae blooms could be located.

Created Fresh Water Lakes. The fresh water lakes created around Truscott Brine Lake will continue to provide fresh water fishing and wetland resources. The larger fresh water lake currently provides over 104 acres, and the smaller lake, still filling, will provide over 30 acres of fresh water habitat.

The nearest alternate fishing resources are over 60 miles from Truscott Brine Lake, and fishing resources judged to be good are over 150 miles away at Waurika Lake or Possum Kingdom Lake.

However, Waurika Lake is in Oklahoma, and Texas anglers would be required to obtain an out-of-State fishing permit.

Fish kills have recently decimated sport fishing in Possum Kingdom Lake, but that resource is expected to recover.

Fresh water lakes to be developed at the Crowell Mitigation Area will provide similar fish and wildlife and recreation opportunities. Creation of fresh water lakes (and the Truscott Brine Lake) is counted as a loss of mesquite/juniper terrestrial habitat. That loss is included in terrestrial mitigation at the Crowell Mitigation Area.

Created Migratory Waterfowl Habitat. Truscott Brine Lake and associated "fresh water ponds" will continue to provide brine and fresh water aquatic habitat and water sources for existing terrestrial species. Additional fresh water ponds would be developed around the Truscott Brine Disposal Reservoir and in the Crowell Mitigation Area to provide additional migratory waterfowl habitat.

Selenium. Brine that originates in some source streams of the Wichita River Basin contains elevated concentrations of selenium (Se), a naturally occurring chemical element. At some brine source areas, naturally occurring concentrations of Se exist at levels reported as hazardous to fish and wildlife, and some streams in the upper Wichita Basin have therefore been formally listed by the State of Texas as Se "impaired". Removing brine from source streams not only removes chlorides, but also removes Se, thereby reducing loads and potentially providing Se-related benefits to fish and wildlife downstream of collection areas. When pumped to Truscott Brine Lake, concentrations of Se have the potential to increase in the reservoir over time.

Evaporation would tend to be the major process that could increase Se concentrations in reservoir waters. In contrast,

other natural processes work to decrease Se concentrations in lake water. These processes include volatilization (transfer of Se from water and sediments to air) and adsorption to sediments. While the relative importance of each of these complex processes is unknown, monitoring at Truscott has shown that somewhere in excess of 87% of the amount of Se estimated to have been pumped to Truscott Brine Lake was not in the water. This finding is based on a 14-year period following impoundment of the lake. As has been reported in a number of other systems, it would appear that natural processes working to remove Se from the water column in Truscott Brine Lake are significant.

Selenium may also be present in lake sediments. Sediments can accumulate Se and play an important role in Se cycling in some aquatic environments.

The illustrated view of Truscott Brine Lake shows the estimated outcome of Se pumped to the lake. Based on studies in other lake systems, an estimated 5% of the Se is released (volatilized) to the air. Risks of Se in the air are minimal to fish and wildlife. A small percentage remains in the water column. This is where risks are greatest to fish and wildlife. The majority, estimated to be 82% or greater, is adsorbed to sediments. The Se in shallow sediments may also represent a potential risk to fish and wildlife. Those risks decrease with sediment depth and are minimal in deep sediments.

Birds are frequently among the most sensitive organisms to elevated Se. In particular, nesting birds which are sedentary and feed in a localized area are most susceptible through feeding on prey (e.g., fish) which accumulate elevated Se levels from water and sediment. Transfer of Se from a bird to its eggs can result in decreased hatching rates and embryo deformities in areas with elevated Se.

Bird species exhibit a wide range of tolerance to Se-related effects. Some species are particularly sensitive to Se while others can tolerate much higher concentrations. In general, bird species adapted to saline environments tend to have higher Se tolerances than those more adapted to freshwater systems. Birds take up Se quickly from the environment, but also lose accumulated Se rapidly (several weeks) when removed from an area of elevated Se.

Certain fish species have also been shown to be very sensitive to Se with reproductive impacts observed in areas with elevated Se.

Processes that affect Se concentrations in aquatic systems and result in impacts on fish and wildlife are extremely complex and often depend on a wide variety of conditions unique to a particular system. For this reason, long-term Se predictions for a given system are very complex with a relatively high degree of uncertainty. Site-specific Se impact analyses are often conducted based on a number of very conservative assumptions designed to be protective of the environment (i.e., overstate impacts). This provides a "safety factor" to deal with the complexity and uncertainty of these issues. This degree of conservatism should always be recognized in inter-

pretation of site-specific findings from these analyses.

Based on a conservative approach and site-specific information obtained to date, the Corps has developed its best conservative estimate of potential future Se conditions at Truscott Brine Lake with implementation of Wichita River Basin chloride control. This involved estimation of water and sediment Se concentrations at Truscott Brine Lake over the life of the project and comparison of these concentrations with "threshold" water and sediment concentrations presented in the scientific literature as protective of fish and wildlife.

It is emphasized that these threshold values have been developed for widespread application across a broad range of aquatic environments and species and are therefore appropriately based on protection of all species (e.g., birds, fish) that could potentially occur in any environment. Threshold values for protection of fish and wildlife have not been restricted to impacts on birds, and their use in specific environments may, in some instances, reflect protection of organisms that would never be expected to reside in a given area (e.g., salmon and trout fish species). Professional judgment and an understanding of the basis for "threshold" concentrations are therefore required in impact analysis for a given site (e.g., a brine lake) and group of organisms of interest (e.g., birds).

Based on studies conducted to date, it appears reasonable to assume that the

FOR BREEDING BIRDS, CONSERVATIVE CONCENTRATION ESTIMATES FOR THE PROPOSED CHLORIDE CONTROL PLAN INDICATE A **POTENTIAL** FOR REPRODUCTIVE IMPACTS ON SELENIUM SENSITIVE SPECIES OF SEDENTARY, SEMI-AQUATIC BIRDS THAT COULD NEST AT TRUSCOTT BRINE LAKE. **HOWEVER, NO SUCH SPECIES WERE OBSERVED AT THE LAKE DURING AN EXTENSIVE 2-YEAR BREEDING BIRD SURVEY CONDUCTED IN 1997 AND 1998.**

recommended chloride control plan could be implemented without future Se-related impacts on non-breeding birds (e.g., wintering waterfowl) at Truscott Brine Lake. Estimated concentrations for all alternatives are below estimated threshold values for non-reproductive impacts.

For breeding birds, conservative concentration estimates for the proposed chloride control plan indicate a **potential** for reproductive impacts on Se sensitive species of sedentary, semi-aquatic birds that could nest at Truscott Brine Lake. However, no such species were observed at the lake during an extensive 2-year breeding bird survey conducted in 1997 and 1998. These surveys were conducted 10 years after the lake started storing brine.

Whether species meeting the criteria (Se-sensitive, sedentary, and semi-aquatic), would nest at the lake is uncertain. Should such species breed at the lake in the future, there is a conservatively estimated potential for reproductive impacts. Accordingly, the Corps proposes that both Se monitoring and an interagency process-based action plan for addressing these concerns accompany implementation of any alternative.

A balanced analysis of Se issues should also include identification of potential Se-related benefits. In addition, should Se concentrations in water and sediment remain low, Truscott Brine Lake may provide Se-related benefits to populations of mobile bird species feeding both in the lake and in surrounding aquatic environments where naturally-occurring Se concentrations are elevated.

While Se levels in Truscott Brine Lake may increase to 6.4 parts per billion (µg/l), the Se concentration in the North and Middle Forks naturally average higher than that concentration and are routinely 50% to 100% higher. However, caution should be exercised in comparing effects of Se concentrations in impounded water to Se concentrations in flowing waters. In stream reaches below the brine collection areas, a potential in-stream benefit may be realized due to reduced Se loads. Reduced Se concentrations in fish have already been measured immediately downstream of the existing collection facility (Area VIII) in 1997 and 1998.

Given the assumed conservative nature of the Se estimates and approach used, it would seem that the potential for Se-related impacts predicted by studies to date is not excessive and is low enough that the recommended plan could reasonably be implemented, provided that adequate monitoring accompanies project implementation.

In contrast to benefits, the prospective to cause environmental impacts was identified. All negative effects on the natural and human environment are of concern to the Corps and are critical elements in the planning process. As different alternatives were formulated, the Corps identified issue areas by speculating on worst-case situations. Then, as data were evaluated for each specific alternative, the actual risk of there being an impact, potential or unavoidable, was determined. The issue areas discussed below are either:

- **Potential** impacts - those, which were identified as likely to occur and can be avoided or which might occur and can be avoided; or
- **Unavoidable** impacts - those which can either be reduced by changing the chloride control design or planned operation, or mitigated by adding an environmental feature to offset or replace environmental losses that cannot be avoided, or
- Either potential or unavoidable, but **inconsequential** impacts.

All changes to environmental conditions are indicators of possible impacts, but not every change to an environmental condition will necessarily result in negative effects. Ecosystems are complex and somewhat adaptive to minor changes. The Corps has carefully evaluated the risks of individual changes and has examined the possibility for those individual changes to "act" together to cause cumulative impacts.

North and Middle Forks. Collecting brine and pumping it away from these streams could cause potential environmental problems. The following summaries review those issues.

Reduced Stream Flow. Pumping brine from the collection areas on the North and Middle Forks would tend to reduce flow immediately downstream. When low flow conditions occur naturally in any of the main tributaries or the dozens of minor tributaries in the Wichita Basin, the resident species of fish are restricted to natural streambed pools and to pools at bridges crossing these streams. This restricted condition then persists until the next rainfall event that is large enough to cause flow in the various streams occurs.

For many of these pools, a small amount of near surface groundwater percolates down the streambed and through the small pools, thereby sustaining the fish. If rainfall does not occur in time, the fish in some pools die due to high temperatures, predation, lack of food, or suffocation.

The chance for chloride control impacts would be where loss of brine from the channel would cause low-flow conditions to be worse immediately downstream of collection areas. Although the change to stream conditions is not expected to cause significant decreases in resident populations of saline tolerant species, the Red River pupfish is unique to the Red River Basin. S*alt tolerant species are neither listed as threatened nor endangered and are present in large numbers throughout the Red River Basin.*

Minimizing impacts to this species is an important Corps objective. The potential for the greatest chloride control effect on flow conditions on the **North Fork** is from zero flows about 0% of the time to zero flows almost 9% of the time. The **South Fork** of the Wichita River already experiences zero flow conditions about 9% of the time and maintains healthy and self-sustaining fish populations, especially saline tolerant species which are adapted to the region's harsh conditions. Similarly, many small tributary streams in the upper Wichita Basin appear to have much higher zero flow conditions, and they also maintain fish populations.

The absence of groundwater information means that Corps projections for North Fork low flows may overstate the change to low-flow conditions.

This conclusion is based on the one operating collection area - Area VIII. Following construction of the Area VIII collection facility on the South Fork in 1987, downstream low-flow conditions have been monitored. The change to low flows downstream of Area VIII is found to be less than initially projected, and the facility reduction of low flows is negligible. In the absence of groundwater data, it is not possible to conclude that the same results would occur below Areas VII and X.

When low-flow conditions are discussed in technical documents, they are referred to as flow conditions equal to or less than zero and may be represented with common mathematic symbols (i.e. "≤"). *While describing a flow less than zero may seem odd, the description is a reminder that although stream flow measured at gages may indicate no flow; very low flows are difficult to detect at unmanned mechanical gages. When a stream is divided into several braids or doesn't flow directly past a gage, no flow may be measured. However, some water may be present, but may be trickling "around" the gage, or percolating through the streambed, just below the surface.*

Brine habitat created by low-flow dams and their attenuation of flows will tend to offset low-flow impacts. Also, brush management proposed for implementation in the watershed would tend to supplement flows.

This was determined to be an inconsequential impact. The distribution and population of fish species in these streams will be monitored for as long as chloride control is in operation and, if problems were identified, adaptive management practices would be implemented to minimize or avoid chloride control impacts to these species. The Corps is very concerned about all aspects of the environment. We will make whatever changes within our means to avoid harm to wildlife or habitat.

Indirect Mitigation of Reduced Stream Flows. To determine the benefits of implementing brush control programs in the Wichita River watershed above Lake Kemp, the Texas Legislature designated the Texas State Soil and Water Conservation Board as the lead agency to conduct comprehensive watershed studies in conjunction with the Texas Agriculture Experiment Station and Extension Service and the Red River Authority of Texas. The United States Department of Agriculture, Natural Resource

Conservation Service estimates that brush in Texas uses approximately 10 million acre-feet of water per year compared to the 15 million acre-feet of water per year currently consumed for all other purposes.

The Wichita River watershed was selected to evaluate the long-term effectiveness of brush control to increase watershed yield and improve land and water resource management practices.

Brush affects runoff in several ways. The two primary effects are interception and transpiration. Brush intercepts rainfall when the surface of leaves and branches get wet and that volume of water then evaporates. The wetted surface of the brush can be several times the area of the ground below. Much of the rainfall that may reach the ground or around the brush can then be "transpired''. The combined effects significantly reduce the amount of water that would soak in or run off the ground.

The Red River Authority's 2000 report, Assessment of Brush Management/Watershed Yield Feasibility for the Wichita River Watershed Above Lake Kemp, evaluated these effects and recognized the existing and planned chloride control features (also incorporated in the State Water Plan for the region). The Authority's recommended plan would not alter the function or operation of the brine collection areas. It would, however, tend to reduce potential chloride control effects on low flows below the brine collection areas by increasing runoff and supplementing stream flows.

The State's brush management plan would be expected to increase stream flow by increasing the runoff of rainfall (freshwater). This would tend to offset the loss of brine flows pumped to Truscott Brine Lake. Increased freshwater inflow into the streams would increase aquatic diversity and overall productivity. The mitigating function of the State brush management plan could tend to partially restore a portion of the Wichita Basin's terrestrial and aquatic habitat to near pre-settlement conditions.

The Corps estimates that increased runoff due to the State's brush management plan in the Wichita River Basin is projected to increase Lake Kemp's yield between about 15,000 and 21,000 acre-feet per year. This estimate is based on a brush clearing implementation level of 50%, starting below brine collection areas VII and X and down basin to Lake Kemp. This element of restoration would also increase cattle production in the basin.

While implementation of brush management is anticipated, it is not a required component or necessary to mitigate chloride control impacts. The low-flow effects of removing brine are relatively minor and do not require mitigating efforts. Low-flow effects that may occur in downstream reaches during periods of drought may be partially offset by creation of brine collection pools above the low-flow dams and flow attenuation immediately below.

The results of removing brine flow from streams (chloride control) and adding fresh water flow (brush management runoff) would have an offsetting effect on flow.

These flow changes may also have a cumulative effect on reducing chloride concen-

trations. Reduced concentrations may be good indicators for water use by people, cattle, and terrestrial wildlife, but this change could allow freshwater species to utilize portions of the brine streams that are currently too salty. Species such as Red shiner, sunfish, largemouth bass, and channel catfish could begin to utilize reaches further upstream. While this tendency may be beneficial for overall stream productivity, it could tend to reduce the numbers of salt tolerant species (including the Red River pupfish).

Saline Tolerant Species Competition. Below the collection areas, the reduced brine flow and the increased freshwater runoff proposed from brush management could allow less saline tolerant species to compete for habitat resources. Exactly what salinity reductions will be present on any particular day is impossible to predict. However, some trends will apply.

- One trend, chloride concentrations immediately below the low-flow dam, would not be significantly lowered – neither by the presence of the collection facility nor by brush management. The low-flow dams do not capture 100% of the stream flow and are designed to capture little, if any, of larger flows produced by larger storms. This design feature has been documented at the operating collection area. *What is reduced is the chloride **load**.*
- The second trend, salinity, would tend to gradually decrease with increasing downstream distance. Through competition with less saline tolerant species, the populations of saline tolerant species would be expected to decline, but this impact is not expected to occur over long periods of time and would likely be limited to short-term pulses of competition which would result from above average rainfall events and associated less saline stream flows.
- The third trend, flow increases that would result from brush management, would tend to restore watershed runoff and stream flow conditions to near pre-settlement conditions, which would tend to benefit the aquatic community as a whole. Although saline tolerant species might be reduced in numbers on a temporary and recurring basis, other species of fish would be present at those times.
- The fourth trend, streams increase in size and flow with increasing distances downstream due to increased drainage area and alluvial (groundwater) contributions. This means that low flow impacts below brine collection areas would not continue throughout the Wichita River. With increasing distance downstream, measured in a few miles, those impacts diminish and are overcome by runoff and groundwater as the stream gets larger.

THROUGH COMPETITION WITH LESS SALINE TOLERANT SPECIES, THE POPULATIONS OF SALINE TOLERANT SPECIES WOULD BE EXPECTED TO DECLINE, BUT THIS IMPACT IS NOT EXPECTED TO OCCUR OVER LONG PERIODS OF TIME AND WOULD LIKELY BE LIMITED TO SHORT TERM PULSES OF COMPETITION WHICH WOULD RESULT FROM ABOVE AVERAGE RAINFALL EVENTS AND ASSOCIATED LESS SALINE STREAM FLOWS.

Saline tolerant species competition was determined to be an inconsequential impact.

Isolation of Fish Species. Avoiding further isolation of fish species, both native freshwater and native saline tolerant species, is a concern of the Corps.

Several man-made structures have already segregated fish populations in the Wichita River Basin from downstream to upstream movement. The first dam on the Wichita River was (probably) constructed in 1886 by the Wichita Water Power Company near Wichita Falls, but was (apparently) washed out within a month. In 1901, the dam to impound Lake Wichita was completed on Holiday Creek. Santa Rosa Lake on Beaver Creek divides that stream roughly in half. On the main stem of the Wichita River, the two lakes, Kemp and Diversion (and two hundred miles of irrigation canals) were completed in 1924.

The result has been that the fish community upstream of Lakes Kemp and Diversion has been isolated from the lower Wichita River for 78 years. Those are the historic man-made features. There are two existing and one proposed chloride control low flow dams that would potentially isolate saline tolerant species above the brine collection areas.

Isolation, specialization, and genetic drift are responsible for the over 100 different species and subspecies of pupfish known to exist in the world. As stated before, avoiding influences on isolation of, specifically, native saline tolerant species is a concern of the Corps of Engineers. Above the low flow dams, there will be negligible impacts to species or habitat. The pools will serve to attenuate flows immediately downstream of the low-flow dams. The pools above the two constructed low-flow dams are rich with saline tolerant species. Similarly, the reaches immediately below the dams are heavily populated with saline tolerant species.

Overall, the brine dams will have little impact on the extent of stream miles the salt tolerant species could travel in the upper Wichita Basin. When measured from the Lake Kemp dam upstream to the low flow brine dams, the free flowing stream reaches total about 170 miles. The saline tolerant species can travel throughout these stream reaches, generally unimpeded by man-made structures. The brine springs and seeps are shortly upstream of the brine collection low-flow dams.

Further upstream of the brine springs, flow is very limited, and streams are dry for most of the summer months, providing little if any habitat. To illustrate this point, during a fish sampling study in 2000, researchers found a total of 8 small pools of water upstream of the three brine collection sites (not including the two larger pools formed by the low flow dams). These eight pools are in 774 square miles of drainage area above the three brine collection locations and are generally located at road crossings. Fish were found in some pools, but significant additional isolation

OVERALL, THE BRINE DAMS WILL HAVE LITTLE IMPACT ON THE EXTENT OF STREAM MILES THE SALT TOLERANT SPECIES COULD TRAVEL IN THE UPPER WICHITA BASIN.

would not occur in the upper Wichita River due to the proposed chloride control measures. Isolation of fish species was determined to be an inconsequential impact.

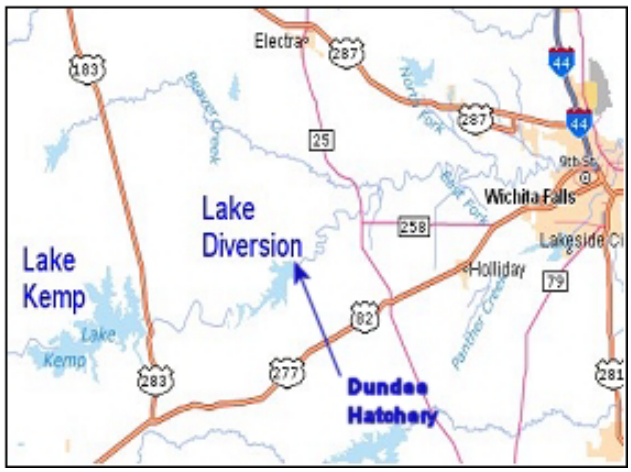
Storage behind the low-flow brine dams will total 112 acre-feet and 49 acres. Although these are artificial pools, which do fluctuate during pumping, they represent large additions to suitable habitat at these locations.

Prevention of Saline Tolerant Species Inbreeding. Because the low flow brine collection dams will segregate the existing population and eliminate migration of those species from downstream fish populations, there is a small risk for saline tolerant species inbreeding in the population upstream of the low-flow dams. Planned monitoring and as-needed stock translocations can avoid the problem. Within the collection area pools, the high chloride concentrations and the collection area's low-flow dam would tend to protect the saline tolerant species from competition.

Saline tolerant species inbreeding was determined to be an inconsequential impact.

Truscott Brine Lake (currently populated by Red River pupfish) represents over 3,303 acres and over 120,760 acre-feet of additional protected habitat. As chloride concentrations rise, the Red River pupfish may be the only resident fish species.

Lake Kemp/Lake Diversion/Dundee Hatchery. Chloride control could result in changes to the operation of these features. The issues are summarized below.



Lake Kemp Draw Down and Dundee Hatchery Withdrawal from Lake Diversion. Lake Kemp is the upstream feature of the three, and is the source for water storage. Lake Diversion is in the middle, and as the name implies, it diverts water to the irrigation canal, the hatchery, and other uses. The Dundee Hatchery is immediately downstream of the Lake Diversion dam. In the aerial photograph, Lake Diversion (A) is on the lower left, the dam is at (B), and the hatchery is in the top center (C). The small rectangles are the hatchery ponds. The Wichita River meanders off the right side of the photo (D), and the Wichita County Water Improvement District No. 2 irrigation canal exits at the bottom of the photo (E).

Lake Diversion pool levels are maintained within a range of 1.5 to 2 feet because of limited functionality of the hatchery water intakes. This means that Lake Diversion cannot be effective in storing intervening runoff, contributing to water supply yield, or providing for flood control.

The hatchery has recently produced essentially all the striped bass used to stock all rivers and reservoirs statewide in Texas. The hatchery is the largest of four in the state and provides several species of fish in support of recreational revenue.

Funding for the hatchery comes from Federal and State sources. In fiscal year 2002, the Federal share of $559,148 is equal to about 57% of the hatchery's annual budget. Wichita County Water Improvement District No. 2 provides water to the hatchery free of charge.

With implementation of chloride control, reduced chloride concentrations are projected to result in an expansion of agricultural water use through conversion of dryland to irrigated farming. Consequently, more of the available storage in Lake Kemp would be used for irrigation. Using more storage means that Lake Kemp will be drawn down to lower lake elevations more of the time.

The State drought contingency plan for Lake Kemp and the current water supply contract between Wichita County Water Improvement District No. 2, the city of Wichita Falls, and the Texas Parks and Wildlife Department's Dundee State Fish Hatchery set the conditions of water distribution. The State drought contingency plan sets decision points for withdrawal of water based on pool elevations in Lake Kemp. Currently, if the Lake Kemp pool elevation would drop to elevation 1123, the drought contingency plan indicates that no water would be allocated to the hatchery from Lake Diversion. The contract sets the amount of water the hatchery is allocated. That allocation is currently 2,200 acre-feet of storage per year, or just over 1% of Lake Kemp's average annual inflow.

The "no water" condition has never occurred, even though the hatchery has, apparently, drawn more water than the 2,200 acre-feet contract allocation in several of the past few years. For the projected greater use of Lake Kemp storage, conservative estimates predict the Lake Kemp pool would be drawn down to elevation 1123 or below as much as 20% of the time. This is a **potential** impact – one that can be avoided and does not relate to the availability of water in Lake Kemp. There appears to be sufficient water supply storage in Lake Kemp to meet all projected needs.

Current water use from Lake Kemp totals just over 98,000 acre-feet per year. Future with-project conditions anticipate total water use from Lake Kemp to increase to just over 159,000 acre-feet per year. The expansion of agricultural irrigation would potentially impact the frequency at which drought contingency plan conditions would be met, but there is no chloride control impact that limits the amount of water for any current use.

The State drought contingency plan can be altered, as can the contract with the Dundee Fish Hatchery. The Corps of Engineers is not a party to the contract or to the

State drought contingency plan. The water supply owners and the hatchery will resolve this issue.

It is noted that implementation of the State brush management plan at only 50% of its suggested area of brush removal between the brine collection areas and Lake Kemp would result in a yield increase which is roughly eight times the volume of the Dundee Hatchery water supply contract. Several State agencies are supportive of the State program to restore mesquite/juniper shrublands to near presettlement conditions.

Even without implementation of the State's cost shared plan of brush removal, individual landowners have actively and continuously been clearing mesquite/juniper lands to create pasture. Yield increases at Lake Kemp would be expected to result from brush management practices.

The Corps does not propose to participate in or integrate a portion of the State brush management program as part of Wichita River Basin chloride control. While brush management appears to be a viable program, it is not a necessary component for implementation of chloride control. The Corps' ecosystem restoration mission may be of assistance in this program in the future.

Section 3. Frequently Asked Questions.

Q1. Why not use point-of-use treatment like reverse osmosis or electrodialysis?

A1. Both reverse osmosis and electrodialysis are proven, technically viable methods of removing salt from water. *Electrodialysis Reversal, called "EDR", uses a membrane, low pressures, and electrical current to remove contaminants from water. The efficiency is similar to reverse osmosis, but may require multiple stages to achieve the desired results. EDR is not suitable for removing bacteria, organics, or other uncharged particles.*

Reverse osmosis, often abbreviated "RO", can remove about 90% of the chemicals in solution, and can remove bacteria, organics, dissolved silica, and more. It works by using high pressure to reverse the osmotic process and force clean water through a semi-permeable membrane while leaving the contaminants behind. In operation, the contaminants tend to collect on the membrane and a highly concentrated waste, about 25% of the volume being processed, is left. In other words, if four gallons go into an RO plant, three gallons of "cleaned" water will result and the fourth gallon will contain almost all the contaminants from the other three gallons. That fourth gallon is considered a waste product and is disposed. This is the environmental issue presented by these types of treatment. The high concentration waste stream is typically returned to the water source from which it came. Putting the concentrated contaminants back in a stream does not change the amount of contaminants in the stream but does change their concentrations until they are remixed (diluted) as they flow downstream. The existing and proposed treatment plants in the Wichita River Basin return all the contaminants (including chlorides) to the environment under regulation by the State of Texas.

The Corps identified a more economical method of chloride control by containing the brine springs at their source and pumping them to a permanent holding area. *This method not only benefits municipal and industrial users, but also benefits agricultural users and many other users at many locations. Municipal consumers would benefit from reduced treatment costs. Agricultural producers would benefit from lower production costs due to greater yields and less water usage. Industrial consumers will have less water treatment costs and less system damage from corrosion.*

The Corps' plan to pump chlorides to an evaporation reservoir will permanently remove that pollutant from the Wichita and Red Rivers. Having chloride control on the Wichita River would reduce the dissolved solids in the proposed Wichita Falls RO plant's waste stream by 66%. This would reduce the plant's operating costs.

Q2. If I shoot and then eat ducks or geese that have stopped at Truscott Brine Disposal Lake during migration, will I get selenium poisoning?

A2. No. Migratory waterfowl may ingest the largest amounts of selenium from naturally occurring brine sources and other water bodies in the region. Non-resident waterfowl may ingest some amount of selenium from Truscott Brine Disposal Lake, or lesser amounts from the nearby fresh water lakes, or varying amounts from surrounding farm ponds or other sources. While migratory birds consume selenium, it is similarly processed from their system. Selenium issues associated with Truscott Lake are related to **potential** impacts to sensitive species of breeding birds, and there are no direct or indirect human health issues.

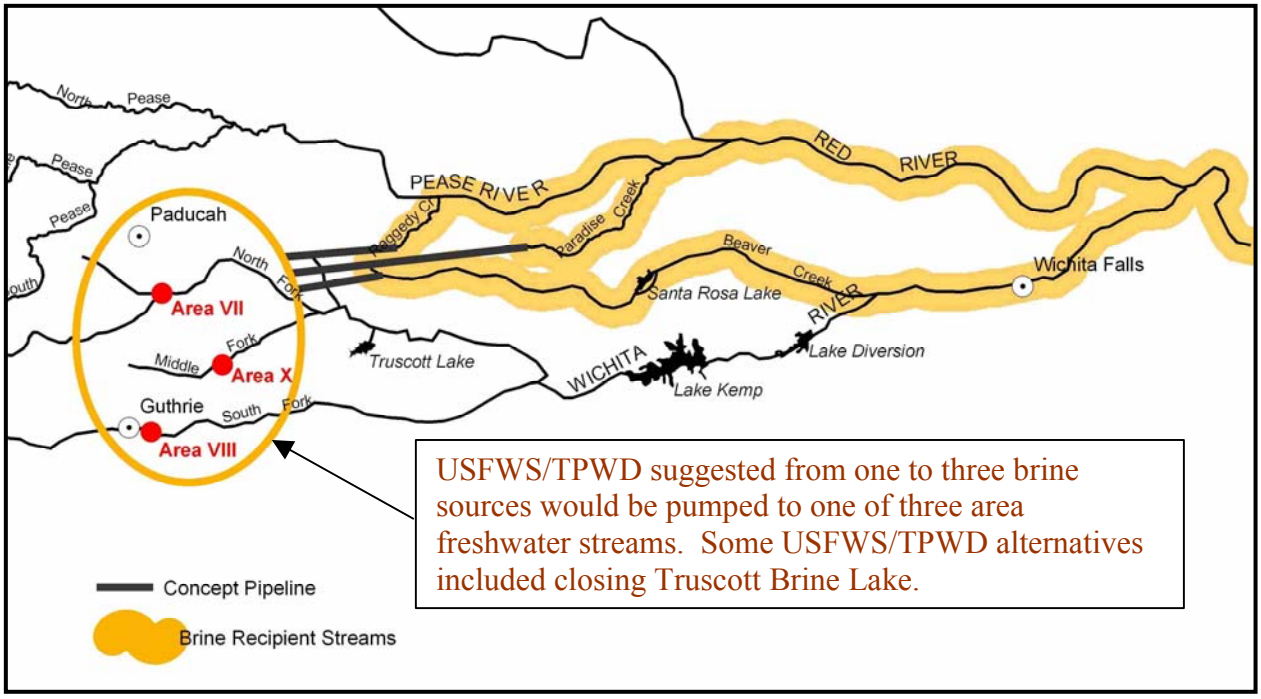
Q3. I've heard there are plans to pump brine into Beaver, Raggedy, or Paradise Creek instead of Truscott Brine Disposal Lake. What's that all about?

A3. At the start of this reevaluation, the Corps proposed 12 varied alternative concepts to set the scope of the study. The Corps then coordinated those concepts with the U.S. Fish and Wildlife Service (USFWS) and the Texas Parks and Wildlife Department (TPWD) in 1998. No variations were proposed by the resource agencies. The Corps then began detailed investigation to evaluate associated technical and economic feasibility and environmental issues of those alternatives. This collaboration is required under the Fish and Wildlife Coordination Act (FWCA) and the National Environmental Policy Act (NEPA). *The Oklahoma Department of Wildlife Conservation (ODWC) provided data, but because the Wichita River Basin is in Texas, the U.S. Fish and Wildlife Service indicated that the Oklahoma agency would not be involved due to minimal effects at Lake Texoma, which is on the Oklahoma/Texas State line (for which the ODWC shares management with the TPWD).*

In the fall of 2001, the Corps completed the last of those studies and coordinated the remaining study results with the USFWS and the TPWD. For the first time since the reevaluation began, those agencies indicated their inability to support chloride control measures as formulated for the Wichita River Basin in Texas.

At that time, the USFWS and the TPWD proposed additional concepts that resulted in 12 additional alternatives. The USFWS and the TPWD expressed that the purposes of their concepts were to avoid or reduce impacts of the Corps' plans, to partially mitigate for impacts, and to potentially reduce long-term costs. One component of their concepts was to avoid or reduce pumping brines to the Truscott Brine Disposal Lake to eliminate potential selenium (Se) impacts. Instead of using Truscott as a brine disposal area, brine would either not be collected at Areas VII, VIII, or X, or would be collected and then pumped to one of three area creeks – Beaver Creek, Paradise Creek, or Raggedy Creek.

For some of the 12 USFWS/TPWD alternatives, this approach could include closure and removal of Truscott Brine Lake. Alternatively, the USFWS and the TPWD suggested that the Corps could continue to use Truscott for brine disposal, but only for storage of brine from collection Area VIII. One or both other brine sources (Areas VII and X) would then be pumped into existing intermittent streams or into stream channels that the USFWS/TPWD suggested the Corps create. *While it was conceivable to evaluate the USFWS/TPWD alternatives related to area streams, the idea of altering the topography of portions of the region to create several miles of new streams to carry the brine flow was not pursued.*



The other component of the USFWS/TPWD concept was to create stream habitat to reduce impacts of low flow days on the North Fork and/or Middle Fork of the Wichita River if brine was pumped from Area VII and/or Area X, respectively. *The USFWS/TPWD concepts would **not** attempt to reduce the potential low flow stream impacts, but would attempt to replace brine stream habitat by converting fresh water streams in the area to brine streams.*

The created stream miles would be about:

1. *5 miles of Raggedy Creek (to the Red River upstream of Vernon, TX), **or***
2. *20 miles of Paradise Creek (to the Red River at Vernon, TX), **or***
3. *60 miles of Beaver Creek (including impacts to Santa Rosa Lake).*

Converting the area's fresh water creeks was suggested by the USFWS and the TPWD as ways to potentially offset perceived impacts of the Corps' plan on low flow on:

- *12 miles of the North Fork below the Area VII collection area to the Truscott gage;*
- *10 miles of the Middle Fork below the Area X collection area to the confluence with the North Fork, and*
- *a portion of about 48 stream miles between the Truscott gage and the downstream confluence of the South Fork. (The low flow impacts diminish between these two gages as stream flows increase with increasing downstream distance. There are no data available between the two gaging stations.)*

The reevaluation completion schedule was delayed for 8 months while the Corps evaluated the array of 12 USFWS/TPWD alternatives. Although it was a limited evaluation, the findings, when compared to the Corps' tentatively selected plan, indicated that less benefits would be gained and reduced levels of chlorides would be controlled. Primarily though, the need for such action was reviewed. The low flow impacts to the North and Middle Forks had been thoroughly examined. The conservative estimate was that a reach of the North Fork would have more low flow days if the brine flow were pumped away, but the impact would be less than on the South Fork where brine has been pumped from the stream since 1987 and where viable populations of salt tolerant species are found above and below the brine collection area. Adding to that finding is the potential for groundwater contributions and brush management flow augmentation that would reduce the effects of brine removal. Also identified were:

- Issues of negative Federal and Texas State agency support,
- A number of environmental concerns (including transfer of water from streams classified as impaired due to selenium concentrations),
- Limited chloride control and environmental outputs,
- General public dissatisfaction (based on limited informal coordination),
- No anticipated local landowner support (particularly related to brine contamination in farming and ranching areas and perpetual restrictive use buffers along the created streams for monitoring and management),
- Opposition from Wichita County Water Improvement District No. 2,
- Opposition from the city of Wichita Falls, and
- Opposition from the Red River Authority.

For these reasons, none of the USFWS/TPWD alternatives was evaluated further. The agencies were provided with a summary report of preliminary findings.

The USFWS and the TPWD continue to favor plans to convert fresh water streams in the area to brine streams, and they recommend the chloride control project not be implemented until the concept is further evaluated. The Oklahoma Department of Wildlife Conservation later indicated that they could not support the chloride control measures as formulated for the Wichita River Basin in Texas due to reductions of chlorides at Lake Texoma.

Q4. After 100-years, what will happen to the Truscott Brine Disposal Lake? Will it have to be treated like a toxic waste site?

A4. No. The discussion of "100 years" is related to the economic evaluation period, not to how long Truscott Lake can function as a brine disposal area. The economic period is used to compare the costs to construct and maintain the facilities to the benefits of chloride control. At the end of 100 years of operation, the project will be capable of receiving more brine for an indefinite period with continued maintenance. Within 100 years of operation, the Truscott Brine Disposal Reservoir will be functioning at a balance where brine flows match evaporation. Unlike some lakes, sedimentation will not be an issue for perhaps 1,000 years.

If technological advances eliminate the need for the project, pumping can be stopped, and the project closed. Data on selenium gathered over the period of operation will provide site-specific criteria, which would guide the way in which the reservoir would be closed. Biological processes in the lake would continue to remove selenium. In contrast, evaporation would serve to concentrate selenium. Monitoring would continue for several years after pumping is stopped to determine whether selenium levels in the pool decrease or increase due to these different processes.

However, if pumping to Truscott Reservoir is stopped, high loads of selenium would again flow down the streams below the brine springs. The potential for selenium impacts to fish and wildlife along those streams is expected to return to current conditions of selenium impairment, as is noted by the Texas Natural Resources Commission and the U.S. Geological Survey.

Q5. Will sediment reduce the storage in Lake Kemp?

A5. Yes. When Lake Kemp was designed, sedimentation was a key consideration. The original plan in 1920's was to gradually increase the depth of the water supply pool to offset the volume of storage lost to sediment filling. The original expectation of sediment filling was apparently over estimated and there is currently more storage available than first projected. The Corps has revised the sedimentation-filling rate based on additional data. The current projection suggests that Lake Kemp will begin to have a reduction in water supply storage in about 75 years, if no other action is taken. There are several other actions that could delay that occurrence. These include:

- Efforts to limit erosion from watershed runoff.
- Upstream sediment traps.
- Reallocation of storage from the flood control pool to the water supply pool.

The estimation of water usage at 75- to 100-years into the future is complicated by many factors. The current estimates my be altered by: changes in agricultural practices; more salt tolerant crops from genetic engineering; municipal usage, conservation measures, or water reuse practices; changes in climate, or population, or industry; or other technological innovations in water treatment. But based on the information available from the past 78 years of operation, there will be sufficient water supply from Lake Kemp for an additional 75- to 100-years without additional efforts to prolong the water supply source.

The sedimentation issue is very important. The monitored amounts of sediment that enter and leave Lake Kemp over the next several decades will indicate how effective efforts in the basin have been in reducting erosion (land management), increasing rainfall runoff rates (brush management), and reducing channel losses (in part, salt cedar eradication). These indicators will then guide decision makers to what opportunities remain available to the Water Improvement District and the City of Wichita Falls.

Q6. Can anything be done to prolong the water supply source from Lake Kemp other than limiting sediment or raising the pool?

A6. Yes. In addition to maintaining or providing more lake storage there are ways to increase the amount of water flowing into Lake Kemp and Lake Diversion. These include watershed programs to remove and manage brush (to provide more runoff) and to remove and manage salt cedar along streams (to reduce the transpiration losses of flows that make it to channels).

Another option is the use of Lake Diversion to increase water supply yields and to provide supplemental flood control. Currently Lake Diversion is limited to pool levels within a 2-foot variance. This limitation to operation (by the Wichita County Water Improvement District No. 2) exists so the Dundee Hatchery can draw water using their aging gravity feed pipes. The hatchery will probably replace the water supply system within the next several years. If at that time it is replaced with a more versatile system, Lake Diversion could be operated to provide an increment of water supply and flood control.

Q7. Will there still be striped bass in Lake Kemp and Lake Diversion if the salt is removed?

A7. Yes. The amount of salt does not appear to be a factor in where striped bass will prosper. The record striped bass in Oklahoma; just less than 50 pounds, was caught in the Illinois River, a salt-free stream. The record striped bass in Texas, just over 50 pounds, was caught in the Brazos River, a relatively salty stream. There are many other examples of striped bass in both salty and fresh streams and lakes.

However, striped bass fishing in Lake Kemp and Lake Diversion is "put and take" fishing and therefore completely dependent on the Texas Parks and Wildlife Department (TPWD) stocking program. For these lakes, that program includes a number of species, including striped bass, which do not reproduce within the lakes. All the striped bass and eight other game species caught from these lakes are put there by the TPWD. The total number of fish stocked since 1963 is over 30 million (about 10% of the Dundee Hatchery's total production). Apparently no suitable spawning habitat for striped bass or some of the other stocked species exist in either Lake Kemp or Lake Diversion.

Striped bass in their natural environment, the ocean, migrate up freshwater rivers to spawn. They are anadromous like salmon and sturgeon. Above Lake Kemp, both flow limitations and high salinities do not allow successful striped bass spawning. It is uncertain whether successful spawning could result from chloride control at Areas VII, VIII, and X and the increased flow and concentration dilution that would result from planned brush management in the basin. Several factors do not favor striped bass spawning above Lake Kemp. These include high water temperatures, low stream flow, and stream reaches that may be too short to allow eggs to be suspended until they hatch.

Q8. I've heard that the water in Lake Kemp, Lake Diversion, and Lake Texoma will be muddy once the chloride control project is built. Won't that hurt the lakes?

A8. There should be no visually noticeable change in turbidity as a result of chloride control.

It's always true that more suspended sediment will be present in these lakes following river inflow caused by a larger rain storm. Larger stream flows carry more sediment and this causes the water to be more muddy or "turbid". A turbidity increase happens now and will happen regardless of the level of chlorides in the water. The amount of sediment that enters the lakes should not significantly change due to changing chloride levels. Essentially all the sediments that enter Lake Kemp will settle somewhere regardless of chloride levels. Some amount of sediments may travel through Lake Kemp and be discharged into Lake Diversion and on downstream.

Typically, more turbid water is in the upper ends of lakes where floodwaters carrying the sediments enter and where sediment resuspension is more likely to occur. Heavier sediment particles settle more quickly. Lighter particles settle more slowly and may be dispersed throughout the lake. Some sediment may also be "picked up" by waves washing against the shore.

The issue of turbidity and the rate at which the water clears is related to chlorides, but really depends on all the dissolved solids in the water. These include chlorides, sulfates, and more components. The effect of total dissolved solids on the lake's suspended sediments is to cause them to settle more quickly than they would in water with less dissolved solids. For a short period of time, the rate at which sediments settle to the bottom will tend to be slower for reduced chloride levels (which reduce the amount of total dissolved solids). In other words, lowering the chloride concentrations will, **in theory**, cause the suspended sediments to settle more slowly because there will be less total dissolved solids.

While the theory holds true and there will technically be a difference in settling time, the difference will not be noticeable without the aid of scientific equipment or laboratory testing.

The whole sediment issue deals with differences in turbidity that can't be distinguished by sight and are, in some cases, less than the accuracy of electronic field instruments. However, in Lake Kemp, depending on the volume of inflow, the amount of sediment in the inflow, varying levels of dissolved solids, the time of year, the wind and waves produced, and other factors, the water may be more or less turbid and settling times may technically be a day or two shorter or longer. Further downstream in Lake Texoma, the effects are anticipated to be extremely small, if detectable.

Q9. Putting a dike around it stopped the salt spring near the town of Estelline, Texas. Why not do that in other places instead of using pipelines?

A9. The geology near Estelline allows the brine spring flow to be stopped by circling the spring with a "ring dike". As the spring fills within the circular embankment (which looks like a pond), the weight of the water becomes too great and the spring stops flowing. This type of containment works at Estelline Springs because the spring appears to be the only place where brine escapes from this underground saline aquifer. The first testing at Estelline Springs was started in 1963 and has been successful to date. The other brine springs or seeps in the Wichita Basin weren't formed in this way – the geology of the underground saline aquifer is fractured.

We know this because of geologic testing at all brine areas and because the concept was tested on the South Fork of the Wichita River near Guthrie, Texas, at

Spring No. 4. By 1964, the test to use "hydrostatic head" (like at Estelline Springs) was stopped because it wasn't working at the South Fork location. These springs seep to the surface through the streambed. If a ring dike surrounded one or more of these seeps, the brine would surface at other locations.

The way to collect these seeps is with brine collection dams that do not put hydrostatic pressure on the brine seeps. A small dam can be located a short distance downstream of the brine seep areas. The brine can then flow down the stream and be held behind the low flow dam. This adds no water pressure on the springs and avoids any impacts to unique species that may reside there and have not been identified. The collection pool then acts as a sump for the pump house.

Q10. Will Wichita Falls be able to use untreated water from Lake Kemp?

A10. No, but water from Lake Kemp could be used in two ways. One way is to use traditional raw water treatment and blend Lake Kemp water with sources from Lake Arrowhead and Lake Kickapoo (sources that also receive traditional treatment). This can be done now, but with fewer chlorides in the water the blended supply could be significantly increased. The other way is to use advanced treatment using reverse osmosis or electrodialysis. This means that the source would expand to the limit of the advanced treatment plant capacity and the storage within Lake Kemp. This could also be done now, but with fewer chlorides and other dissolved solids in the water the cost of treatment would be reduced.

Q11. If there is more irrigation water used from Lake Kemp and the lake level is lower, won't that hurt fishing?

A11. No, not directly, and the Corps proposes measures to offset the minor indirect effects. Lake levels would be lower more of the time. The indirect impact occurs because of the limited vegetation that exists in the pool and around the shoreline. While pool fluctuations are not projected to impact those species that do spawn within the lake, those young fish (and stocked fry and fingerlings) need cover that generally doesn't exist around the lake and is not present within the pool. The Corps proposes that suitable brush row habitat be placed within selected coves at appropriate depths. This should improve shoreline cover and benefit both native species and non-native sport fish species. Locally initiated efforts could provide for this need. Brush rows are relatively inexpensive to develop and can last for 10 years or more.

Q12. I've been at meetings where the Texas Parks and Wildlife Department said the chloride control project would cut off water to the Dundee Hatchery and they would lose everything. What's the Corps going to do about that?

A12. The Texas Parks and Wildlife Department has publicly stated that if the chloride control project is built they will be out of water as much as 40% of the time. That figure is in error. While a potential impact might exist, that impact is

completely avoidable if the parties to the existing contract are willing to negotiate a change. In fact, there is no shortage of water related to chloride control. The cutoff to which TPWD refer is related to a Lake Kemp elevation initially set in the State's drought contingency plan. *Keep in mind that Lake Kemp stores the water, Lake Diversion diverts the water, and the hatchery intake is from Lake Diversion.* The chloride control measures do not reduce the amount of available water from Lake Kemp or cutoff any sources of water. The percentage figure actually relates to how intensively Lake Kemp would be used for irrigation with better water quality resulting from chloride control.

At current chloride concentrations, all water uses may be up to 98,050 acre-feet of water per year. At that rate, Lake Kemp's pool is predicted to rise and fall, but (almost) never be below elevation 1123. *Elevation 1123 is the point in the existing drought contingency plan where water would be cutoff to the hatchery.*

With the chloride control areas in place, the water will be of better quality and its use is projected to increase to 159,000 acre-feet per year. Most of that more intensive use is projected for irrigation. To evaluate the greatest potential impact to lake fluctuations, the Corps estimated that the maximum amount of 159,000 acre-feet would be used every year. At that maximum rate, Lake Kemp will be at or below elevation 1123 about 20% of the time. However, there is additional storage below that elevation and the effects of chloride control do not limit the amount of water available. Meeting the drought contingency plan condition is an effect of chloride control, but one that can easily be avoided. The drought contingency plan and storage contract can be altered. No cost or mitigation feature is associated with the chloride control project.

The Texas Parks and Wildlife Department has suggested that the Corps should mitigate for this "impact" with various measures. Suggestions include building a new hatchery (and providing land and water rights, potentially at Lake Texoma); a golden algae water treatment plant, and a pump-back station to return fishpond wastewater to Lake Diversion. None of these suggestions are currently under consideration by the Corps.

Q13. If the Wichita Falls reverse osmosis treatment plant puts the salt back in the Wichita River, won't that lower the chloride control project benefits?

A13. No. The chloride control benefits are only counted for the chlorides removed by the brine collection areas in the upper Wichita River. The collection areas would not remove all the chlorides from those salt sources (or the Wichita River). The proposed RO treatment plant would use a portion of the flow (indirectly) from the Wichita River and within that portion there would be uncontrolled chlorides. These uncontrolled chlorides would go into the RO plant.

Then, they would be discharged back into the Wichita River. The RO plant would not increase or decrease the amount of chlorides in the Wichita River.

Q14. The Truscott reservoir was sized to hold brine pumped from two collection areas. How can it also hold brine from Area VII as well?

A14. The brine would pass through an evaporation field at each collection site before being pumped to the Truscott Brine Disposal Reservoir. Then after arriving at Truscott, but before flowing into the reservoir, the brine would pass through another evaporation field. The additional evaporation reduces the volume of brine to be pumped and stored. One test site has been operating at the Truscott Brine Disposal Area using the brine pumped from Area VIII for about a year.

Current estimates still indicate a potential need for 2.4 feet of freeboard to be added to the top of the embankment and spillway in about 75 to 100 years. The cost of that addition is included in the project cost estimate, but construction would be deferred until the increase was needed, if needed. An opportunity exists to avoid any increase to the dam height by optimizing brine collections and evaporation field operations and by limiting the fresh water runoff in Truscott's Bluff Creek Watershed through development of additional fresh water ponds. Delaying this construction allows observation of changes in regional weather patterns, such as rainfall, wind, humidity, and temperature, before making a final decision on a relatively minor embankment change.

Q15. Why not just dam up the streams where the brine is?

A15. In part, see the answer to Question 9. All other brine sources, except Estelline Springs, are in areas where the geology would "leak" if brine were stored there. And where they would leak to would be downstream, thereby making them ineffective. The site of the Truscott Brine Disposal Reservoir was carefully chosen for its watertight geology. The site is on "Choza" shale, a Permian aged shale layer up to several hundred feet thick. The brine reservoir can hold the brine above ground while it evaporates and not let it leak into local groundwater. Truscott Lake was sized for and the system was designed to collect and store only the more concentrated low flows. Whenever a moderate or large storm event occurs, the fresh rainwater dilutes the brine. The low-flow collection dams do not capture these relatively large volumes of water. This minimizes the size and cost of these structures and minimizes water supply and environmental effects.

Q16. How is the Red River Authority involved in the Chloride Control Project?

A16. The Red River Authority is the state sponsor for the Red River Chloride Control Project. The following is from their web site:

> "The Red River Authority was created in 1959 by acts of the 56th Legislature as a political subdivision of the State, a body politic and corporate under Article XVI, Section 59 of the Texas Constitution. Article 8280-228, Vernon's Annotated Texas Civil Statutes (VATCS) is the Authority's Enabling Legislation and enumerates its statutory obligations." And this: "The Red River Authority's role in the project is to represent the best interest of the public and insure the most economical methods are employed to reclaim the Red River water resource and made available for beneficial uses of the public as the needs arise. The Red River Chloride Control Project appears to be the most economical means to accomplish this task and achieve an equitable balance between the needs of the public and the environment as efficiently as possible."

For more information about the RRA, try their web site at:
http://www.rra.dst.tx.us/aboutrra.cfm

Q17. How is the Wichita County Water Improvement District No.2 involved in the Chloride Control Project?

A17. *The following is compiled from and includes excerpts from notes prepared by Elmer Parish, Attorney for Wichita County Water Improvement District No. 2 in 1978 and by Jimmy Banks, District No. 2 Manager, for the Iowa Park Centennial, published by the Iowa Park Leader, October 1988*. To understand how District No. 2 is involved, a little history of District No. 1 needs to be covered. The first watershed district (**District No. 1**) was created in 1919 as a public utility and covered 15,543 acres, including all of the city of Wichita Falls. District No. 1 was formed primarily to construct Lake Kemp and Lake Diversion to supply municipal water to the city of Wichita Falls, Texas, and, as its secondary purpose, flood control.

An additional district was proposed for the overall plan of lake development and **District No. 2** was formed in 1920 for irrigation and a secondary purpose of flood control. District No. 2 was established with a total area of 76,784 acres and 43,000 acres classed irrigable.

Construction was started on Lake Kemp in 1922 and completed in 1924. In 1923, the two districts agreed to a contract that established the districts as joint owners and operators. Then, in 1961, the city of Wichita Falls annexed District No. 1 and assumed all obligations and responsibilities. District No. 2 now performs all maintenance and operates the entire system under a maintenance and operating contract, but the city holds roughly 64% ownership of the joint assets.

The expectation of the city is that control of natural chloride pollution will make Lake Kemp water usable for municipal water supply. The expectation of District No. 2 is that chloride control will make Lake Kemp water more productive for irrigation.

Q18. How is the City of Wichita Falls involved in the Chloride Control Project?

A18. First, see the answer to Question 17. Several aspects of chloride control would benefit the city. Foremost is the general availability and usability of Lake Kemp as a water supply source. The nature of that use may be for blending with sources from Lake Arrowhead and Lake Kickapoo or use with advanced treatment such as the proposed RO treatment plant. Having chloride control on the Wichita River would reduce the dissolved solids in Wichita Falls's proposed RO plant by 66%. This would reduce the plant's operating expenses.

Q19. Brush management is part of the state water plan and the state is willing to pay 75% of the cost of removal. The Red River Authority recommends clearing away most of the 825,000 acres of brush in the Wichita River Basin and they have never mentioned mitigating for brush removal. Why does the Corps need to mitigate for the removal of less than 5,000 acres of brush along the pipelines, access roads, fresh water lakes, or the brine lake?

A19. For any proposal for Federal work affecting any stream or other body of water, the Fish and Wildlife Coordination Act (FWCA), as amended, 16 U.S.C. 661 et seq., requires the action agency to consult with the U.S. Fish and Wildlife Service and State wildlife agency(s) with a view toward preventing losses and damages to wildlife resources. The Act also states that wildlife conservation shall receive equal consideration with other features of water resource development programs.

It further requires that full consideration be given to recommendations by the resource agencies including mitigation measures. Because the Red River Chloride Control Project is a Federal work, it is subject to requirements of both the FWCA and the National Environmental Policy Act (NEPA). Consequently, the Corps must consider all impacts associated with the proposed chloride control efforts and consider recommendations for mitigation of fish and wildlife losses and impacts.

That portion of Texas Senate Bill 1 pertaining to brush management is a State-administered program and is not subject to Federal statutes unless Federal funding is involved.

Q20. Texas A&M has documented a reduction of shrubland cover in the eight counties in which the Wichita River Basin is contained. From 1977 to 1997 the total reduction has been about 45,000 acres of shrubland in those counties. If this

trend of shrubland clearing continues, why would the Corps mitigate for brush removal related to constructing project features?

A20. First see the answer to Question 19. The current trend for removal of mesquite and juniper is primarily due to landowner actions. Unless Federal funding is used for programs associated with brush removal, Federal statutes requiring environmental protection or mitigation are not applicable.

Q21. Why spend any more money to finish the other chloride control areas if area VIII is paid for and working?

A21. Area VIII has been pumping brine to Truscott Brine Disposal Reservoir since 1987 and has stopped 1.8 billion pounds of chlorides from flowing down the Wichita and Red Rivers. While this is a measurable reduction in chlorides, the rate of that removal about 378,000 pounds per day, the other brine sources have discharged about 600,000 pounds per day down the Wichita River. These numbers deal with only chlorides. Other large volumes of dissolved solids would also be permanently removed from the Wichita and Red Rivers. Removing brine from the three source areas was a system design, and Area VIII is only one of three brine collection areas in that design. Sustaining the greatest level of control with the most economical benefits while minimizing environmental impacts is the purpose of that system. That purpose cannot be realized without completing Areas X and VII.

Q22. Who owns and operates Lake Kemp and Lake Diversion?

A22. The city of Wichita Falls and Wichita County Water Improvement District No. 2 own the dams and reservoir storage. They operate the project for municipal, industrial, and agricultural water supply and for flood control.

The Corps of Engineers directs the flood control operations.

The Waggoner Ranch owns all property around the lake and controls the fee access to cabins and water recreation.

The Texas Parks and Wildlife Dundee Hatchery stocks the lakes and the TPWD Law Enforcement Division enforces recreation statutes and regulations. The Dundee Hatchery operates two water withdrawal pipes from Lake Diversion, which is their sole source of water. The hatchery receives water free of charge from the joint owners, the city of Wichita Falls and Wichita County Water Improvement District No. 2.

Q23. I've heard that striped bass need a lot of salt in the lakes and rivers to live and reproduce. If all the salt is taken out what will happen to the striped bass?

A23. Striped bass thrive in a variety of salt and fresh water habitats, but appear to seek out the freshest water available to begin their reproduction cycle.

The chloride control project would not be expected to affect striped bass in Lakes Kemp, Diversion, or Texoma nor in the Wichita or Red Rivers. Also, the proposed chloride control project will not remove all of the salt. It will remove about 83% of the chlorides and 67% of the sulfates from the Wichita River.

Q24. Striped bass fishing in Lake Texoma is really good for the area economy. Will the Wichita River Basin chloride control project or anything else affect that?

A24. The Wichita River Basin chloride control project should not affect the striped bass fishery in Lake Texoma, or Lake Kemp, Diversion Lake, the Wichita River, or the Red River. After detailed evaluations of salinity, total dissolved solids, total ionic strength, turbidity, flow, and other parameters, there is no potential for significant impact to the striped bass or other fishery at Lake Kemp due to the Wichita River Basin chloride control project. Effects at Lake Texoma are modeled to be insignificant.

However, normal sedimentation in Lake Texoma (not related to chloride control) may impact the striped bass fishery in the future. About 13,000 acre-feet (equivalent to 13,000 acres, 1-foot deep) of sediment accumulate in the lake in an average year. The majority of the sediment is deposited in the upper end of the lake. Over time, sedimentation could impact water temperature patterns which influence fish distribution in Lake Texoma.

Q25. If concentrated brine is accidentally released from Truscott Brine Disposal Lake, will it cause toxic algal blooms like the ones that hit lakes in Texas?

A25. No and there is no reasonable scenario for such an event to happen. There are no regulated discharge facilities (no outflow pipes) at Truscott lake, so no one can accidentally release brine.

The scenario in which brine could be released requires several conditions to be met and still does not have any relevance to an algal bloom. First, the brine pool would have to have filled from pumped flows. *Although the brine pool will "fill" that doesn't mean it will be "full" and can't hold more brine. The pool is expected to fill in about 75 years. At this point, the inflow from brine (and rainfall) and will be equal to the rate of evaporation. The pool will fluctuate due to more or less rainfall and more or less evaporation from year to year, but will tend to balance around elevation 1502.* Second, a large storm event would have to occur in the Bluff Creek watershed and the brine reservoir would have stored all the runoff from a 100-year event. Third, more runoff from a storm larger than a 100-year event or another storm would soon have to occur in the Bluff Creek watershed. When all three conditions were met, water would begin to flow over the uncontrolled spillway. *The spillway is designed to prevent damage to the dam.*

However, the chance of a toxic algal bloom is not likely. To have met these three conditions, one or more large, most likely regional, storms would have to occur. As a regional storm, it would have dumped large amounts of rainfall not only on the Bluff Creek watershed, but also on the Wichita River Basin. A 100-year plus event would result in a very large amount of runoff. High, if not record, stream flows would be occurring throughout the region. If concentrated brine were to flow from Truscott Lake to the North Fork of the Wichita River, it would be quickly diluted.

To further diminish the possibilities, there is a reasonable expectation that the Truscott release would be relatively fresh water from the storm event(s). The salt and other chemicals in solution in the brine make it "heavier" than fresh water. The more concentrated the brine, the heavier the solution. The lighter fresh water could potentially be stored on top of the brine and would be the only water discharged over the spillway.

Lastly, to our knowledge, algal blooms have not been associated with regional flood events, but have more often been experienced during dry or drought conditions like those cases at Possum Kingdom, Lake Granbury, Lake Whitney, and the Dundee Hatchery.

Following a large pool increase, evaporation would begin to reduce the pool. Average annual evaporation is over 60 inches per year.

Q26. How much brine would be removed by the project and what is in the brine?

A26. Brine sources at Areas VII, VIII, and X will, on average, contain about 888 tons of dissolved solids. Within that 888 tons per day, 491 tons will be chlorides and 179 tons will be sulfates; the rest will bee other dissolved solids. The chlorides removed at the brine sources will be about 83% of the total chlorides released to the Wichita River by these seeps. Much of the chloride load that is not controlled will pass by the collection areas during local or regional rainfall events. At these times, the concentration of chlorides is lower due the much larger amounts of runoff that can occur. It is impractical and not cost effective to try to collect these larger stream flows. The size of the brine disposal reservoir to contain these flows would have to be much larger (and more costly), and the pumps and pipelines would also have to be larger (and more costly to construct and operate).

At Lake Kemp, without chloride control, the chloride concentrations will generally range from about 700 milligrams per liter to about 2,000 milligrams per liter. With chloride control, the chloride concentrations will generally range from

about 170 milligrams per liter to about 500 milligrams per liter. The Texas water quality standard for chlorides in drinking water is 300 milligrams per liter.

Q27. What is brush management?

A27. In 1999, the Texas Legislature funded research to study the extent to which brush control may increase water yields in eight Texas watersheds (including the Wichita River Basin). Removing brush and managing the cleared areas provides agricultural and water resources benefits. For agriculture, cleared lands can be used more productively (such as greater grazing production) or for alternate uses (such as conversion from no use to grazing, hunting, farming, or a combination). There may be wildlife benefits due to land use conversion or controlled burning (where fire control access to areas is currently excluded). For water resources, there may be several benefits. The reduction of evapotranspiration (interception evaporation and transpiration) will allow more runoff to increase stream flow, reduce low flows, and increase the dependable yield of water supply reservoirs. Wildlife, cattle, irrigated crops, and people would benefit from more runoff. When managed properly, erosion can be reduced which also has stream and reservoir benefits. The management aspect maintains the value of the expenditures initially used to clear the lands by assuring it remains cleared for many years into the future. Part of management also deals with recognition of wildlife that may use or prefer the cover and forage provided by brush habitat. Brush can be cleared and managed by chemical, manual labor, and mechanized methods. Each has different costs and is appropriate in various situations. *The Corps and the Red River Authority are discussing ways to implement brush control within the State's program and the Corps' Environmental Program. Brush management is not part of the chloride control measures nor is it included as a mitigation measure. It is recognized as a potential state program that could affect stream flow and chloride concentrations. Those potential effects were examined within the Reevaluation study.*

Q28. Who would pay to operate the chloride control project or a reverse osmosis treatment plant?

A28. The Federal Government will fund the operation of chloride control facilities unless a local sponsor offers to assist or take over that responsibility. The Corps has not identified a local sponsor who desires to assume the financial responsibility of operating chloride control facilities. The water users, whether a company or an individual consumer, would typically pay for operation of advanced treatment like reverse osmosis.

Q29. I hear that salt-cedar will take over the upper Wichita River tributaries when the chloride control project is built. Does that mean that I can't clear them on my land?

A29. Salt-cedar in area streams will continue to out-compete native plants unless landowners intervene. Without intervention, the salt-cedar will continue to expand and damage the aquatic and riparian environments in the Wichita River Basin. Texas farmers and ranchers are encouraged to eliminate salt-cedar in favor of willows, grasses, and other native riparian plants.

Less salt in the Wichita River tributaries will support the landowner's efforts to replace salt-cedar with native plants. Without the reduction of salt in these streams, the salt-cedar's tolerance to salt will favor it to out-compete all other native species.

A biological control agent under study by the Texas A&M University Department of Entomology may soon supplement traditional removal methods.

MORE SALT-CEDAR INFORMATION: *In the 1800's, Tamarix (salt-cedar) was imported to both U.S. coasts. It may have been intended for various purposes: an ornamental shrub; windbreaks; and to protect stream banks from erosion. By 1950, it had spread to streams in several western states and is now causing problems in 13 western states. It grows well in arid climates and survives by sending roots deep into the soil. It primarily reproduces by flowering (small pink to white, 4- or 5-petalled blooms in the spring and summer), and the wind and water spreads the seeds. The seeds have little protein value to wildlife and are too small for most animals, compared in size to fine ground pepper or pollen. The seeds may even germinate while floating on water. Damaged or cut salt-cedar can spread by re-sprouting from the roots. Under the right conditions, it can grow 9 to 12 feet in a year, with most plants ranging from 5 to 20 feet tall. When the plant matures, it can produce up to one half million seeds a year and can transpire about 200 gallons of water per day.*

Unfortunately, this shrub spread from its intended uses and now dominates many streams. Salt-cedar changes the soil chemistry around it by secreting salt from stems and leaves, which eventually fall to the ground forming a salt crust that inhibits the growth of native plants. To make matters worse, the wildlife that benefit from native plants tend to not utilize salt-cedar. If not removed, salt-cedar can negatively alter the plant and animal communities in riparian areas along streams, clog streams impacting fish and other aquatic species, and consume a large percentage of the stream water. Honeybees do benefit from the source of pollen and nectar.

Many State and Federal agencies are actively involved in salt-cedar control or eradication programs. The Corps' environmental mission is applicable for the control of salt-cedar and is available to local sponsors. The Corps and the Red River Authority are discussing opportunities to work together under the Corps' Environmental Program to help control salt-cedar.

Q30. Where did striped bass come from and will they be harmed?

A30. The U.S. Congress directed the Corps to evaluate chloride control in 1959. The Corps had actually coordinated several chloride control studies for the Red River Basin with the U.S. Fish and Wildlife Service and with Texas and Oklahoma State agencies before stocking of striped bass began. When these agencies decided to stock non-native striped bass and hybrid striped bass in Lake Texoma for recreational benefits, they were aware of the chloride control project, its purpose, and the studies of chloride reduction and effects.

The Oklahoma Department of Wildlife Conservation stocked Lake Texoma with striped bass from 1965 until 1974. There have been chloride reductions at Lake Texoma before and since that stocking program, but no adverse impacts on striped bass fishing have been documented.

Every day since January 1964, Area V has stopped about 240 tons of chlorides from entering the Red River (and Lake Texoma). Since May 1987, Area VIII has stopped 165 tons per day of chlorides from entering the Wichita and Red Rivers (and Lake Texoma). Major progress has also been made in the reduction of man-made brine contributions to the Red River Basin (including Lake Texoma). The Red River Authority of Texas reports that control of oil field brine disposal operations have reduced 85% of the man-made pollution to the Red River since 1980. That man-made brine reduction accounts for over 968 tons per day that have been stopped from entering Lake Texoma between 1980 and the present.

After all these reductions, there is still no evidence of any effect on striped bass fishing or any other recreation. The striped bass finding is not remarkable because striped bass do well in both fresh and saline water. They are generally raised in freshwater hatcheries. They tend to seek out streams for spawning that have the least salinity.

Since striped bass stocking in Lake Texoma was stopped in 1974, the Corps has conducted a large number of additional studies of all facets of chloride control effects. The results provide better information about potential impacts of existing and proposed chloride control features. All the recent studies estimate even less effects than were estimated in prior studies. Current data for Wichita River Basin chloride control indicate an insignificant change to any conditions that relate to the striped bass fishery in Lake Kemp, Lake Diversion, or Lake Texoma. Also, these

studies show an insignificant change to any conditions that relate to the fishery resources in the Wichita River, the Dundee Hatchery, or the Red River.

Q31. How much of the water from Lake Texoma is going to be sold to the North Texas Municipal Water District?

A31. Implementing chloride control measures in the Wichita River Basin was not projected to change the current amount of storage under contract by the North Texas Water Development District.

Q32. Are there endangered species that will be affected by chloride control in the Wichita River Basin or downstream?

A32. No. There are no expected impacts to Federal threatened or endangered species. The Federally listed species that may occur in the Wichita or Red River Basins are birds and consist of the Whooping Crane, Bald Eagle, and the Interior Least Tern. Also, no impacts are expected to Oklahoma or Texas state listed species. All species are discussed in the Corps' environmental statement.

Q33. Will wetlands be lost due to the construction of or results of chloride control on the Wichita Basin?

A33. Chloride control construction efforts will avoid direct impacts to wetlands.

There should be no indirect impacts to wetlands. The principal reason is because landowners are more concerned about good land management practices and the environment than ever before. A number of agencies can assist in avoiding impacts to wetlands (or native riparian habitat). The expected changes from chloride control in the basin that would potentially impact wetlands involves conversion of non-irrigated to irrigated lands.

The thought process for this issue has been that fresher water will cause landowners to indiscriminately convert wetlands to irrigated fields. For a number of reasons, that process is unlikely. First, and most unfortunately, most wetland impacts have probably already occurred. In the past, there were Federal and State incentives across the nation to drain "swamps" and expand agriculture. Most everyone is now more aware of the value of wetlands and many efforts are underway to protect those that remain and restore functions that were lost. The Red River Authority of Texas and Wichita County Water Improvement District No. 2 also support protection and restoration measures and have pledged to monitor and inform current and prospective landowners of the value and benefits of wetlands.

Texas A&M University assisted the Corps in inventorying current land use and projecting future land use with chloride control. That assessment indicates that

essentially all land use conversion would be from dry farming to irrigation farming and none would be from wetland or riparian habitat conversion to irrigation farming.

Q34: In addition to decreased dissolved salts, are other changes in water quality in the Wichita River expected to occur with the project?

A34: Potential changes in some reaches of the river could include increases in nutrients (nitrogen and phosphorus), pesticides, and certain metals as a result of increased irrigation return flows. Potential for these changes would be greatest in areas where increased irrigation occurs. A program has been established to monitor these potential impacts.

Q35. How can I get more information about chloride control?

A35. The last page of this handout has contact information. Everyone is encouraged to ask questions or express opinions – pro or con.

Q36. Who pays for the chloride control project?

A36. The Federal Government has paid for all studies, construction, mitigation lands, and operation to date in accordance with legislation that authorized the project for control of natural chlorides. The Red River Authority, the Red River Valley Association, the city of Wichita Falls, Wichita County Water Improvement District No. 2, and others have contributed their efforts and data resources. State or local governments can contribute financially to Federal studies, construction, or by assuming operating responsibilities, but the Corps has not identified any sponsors who desire to share in the cost of construction or maintenance of the chloride control features.

The State of Texas, through the Red River Authority, has tackled the problem of man-made brines. The following is from their Wichita River Basin, Chloride Control Project, Summary Report, May 2000, Revised 06-14-2000: "Pursuant to the agreements entered into between the state and the federal governments, the states have been controlling approximately 85% of the man-made pollution to the river system since 1980. The total cost to control man-made pollution is approximately $152 million through 1999, with an average annual cost in excess of $7.3 million to maintain such controls. Over 968 tons of chlorides are being eliminated daily from entering the Red River watershed above Lake Texoma which were originating from oil field brine disposal operations. This reduction in chloride levels since 1980 does not appear to have inhibited the aquatic life habitat or striped bass proliferation in any area lakes within the region."

Q37. What happens if a brine pipeline breaks?

A37. The brine conveyance facility utilizes advanced leak detection equipment that will automatically shut down pumping operations if the flow at one checkpoint

does not match the flow at the next checkpoint. If a leak is detected, that pipeline system immediately stops pumping and pipeline valves along the route automatically close to minimize the loss of brine at the leak. Repairs can be made within 48 hours and the system restarted. Because the pipeline is underground, excavation is required at the leak location. Immediately following repair, the site is graded and worked to minimize any saltwater impacts and is reseeded with native grasses. The landowner is notified when a leak occurs and is asked to examine the location both during and after the repair. The pipelines are within a real estate easement, but the landowner holds title to the land.

TO LEARN MORE

US Army Corps of Engineers
Tulsa District

- The Wichita River Basin Project Reevaluation and the draft Supplement to Final Environmental Statement for the Authorized Red River Chloride Control Project, Wichita River Only Portion, will be released for public review and comment in July and August 2002. Copies will be available for review in local libraries. Online review will also be available at: www.swt.usace.army.mil

- Public meetings will be held as part of the National Environmental Policy Act (NEPA) coordination.

- The Red River Authority of Texas (RRA) will be sponsoring information meetings.

- Comments are most appropriate during the NEPA public review period, but may be made at any time. Contact information is below.

Environmental Comments

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